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THE METAL INDUSTRY

WITH WHICH ARE INCORPORATED
THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER
ELECTRO-PLATERS REVIEW

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THE METAL INDUSTRY
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ELECTRO-PLATERS REVIEW.

Vol. 19 NEW YORK, JANUARY, 1921 No. 1

New Casting Shop of the Bridgeport Brass Company

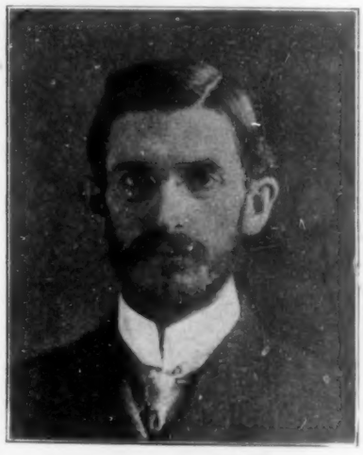
The Construction and Method of Operation of a Shop Running Entirely on Electric Furnaces

Written for The Metal Industry by H. M. LANE, President, The H. M. Lane Company, Detroit, Mich.

In the old-fashioned casting shop brass was melted in a crucible, usually with hard coal as a fuel. In this process a stack was necessary to create the proper draft in the furnaces and to carry off the products of combustion from the fuel. Naturally there were heavy zinc fumes that passed up the stack with the products of combustion, but owing to the fact that there was very little free oxygen in such a furnace, not as much metal passed up the stack as escaped when the pot was first pulled from the furnace or during the casting operation. With this style of melting there were not only the cumbersome and heavy stacks, but also the trouble of handling the fuel, the ashes, stoking the furnace, cleaning the fires and the hot work of pulling the pots and pouring from a pot that was radiating heat from all over its outside surface.

FIG. 1. POURING A BILLET FROM THE AJAX-WYATT FURNACE

With electric melting there is no flow of gases through the furnaces, no possibility of contaminating the metal by the fuel, and hence no necessity for a stack during the melting operation. However, in either pouring operation much smoke arises, and this is a problem which must be taken care of in the casting shop itself.



H. M. LANE

At the Bridgeport Brass Company casting shops there were formerly several stacks, all of which disappeared when the electric furnace took place of the pit fire type.

In the original electric furnace casting shop the furnaces were arranged on both sides of the building as shown in Fig. 1, which also incidentally shows the big volume of smoke or fumes to be contended with at pouring time. In the old shop these fumes could not be made to flow out satisfactorily.

What was done was to tear off the old monitor and the portion of the roof between the monitor and the yard and to take out the side wall of the old casting shop. The space between the casting shop and the road, which was a tapered piece of ground, was then filled in to form a building, an interior construction view of which is shown in Fig. 2. A furnace platform was run down through the middle of the building, one row of the columns upon the platform being the old side wall of the casting shop. The valley of a Pond truss was brought immediately over this platform and the furnaces placed at each side of the platform, so that the smoke tends to rise into the high points of the truss and flow out, and by proper control of the side wall inlets and the outlets in the truss the fumes are swept up and out, making the new shop a much better place to work in than the old.

To ensure plenty of fresh air inlets along the casting platform a tunnel was run the entire length under

the casting platform and connected to a series of vents in the side walls by cross tunnels. The transformers for the electric furnaces are located in this tunnel, as

FIG. 2. INTERIOR OF CASTING SHOP OF BRIDGEPORT BRASS COMPANY, BRIDGEPORT, CONN.

are also the bus-bars and some auxiliary machinery. The balance of the tunnel is used for storage of mold.

There are openings in the side wall of the tunnel in the portion that projects above the floor behind

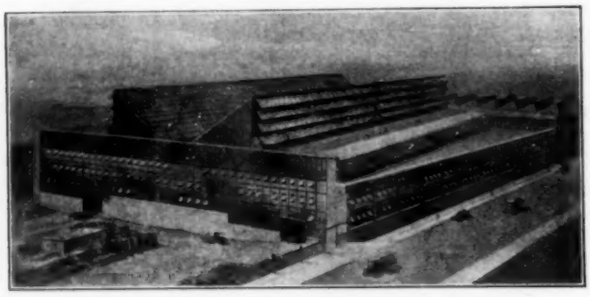


FIG. 3. OUTSIDE VIEW SHOWING POND TRUSSES

each furnace, so that fresh air flows up each side of the furnace, getting under the fumes and tending to lift them. Between the two rows of columns on the charging platform there is a small crane which handles all metal from the stockroom to the furnaces and in front of each row of columns there is a large crane which can be used for changing or repairing furnaces, handling the metal, after it is cast into bars (for the sheet rolling mill) billets (for rolling mill and extrusion shop) and shells (for the tube mill), or for handling the molds.

The furnace platforms are so arranged that a man has access to all parts of the furnace and a perfect control of it during pouring.

At the left of Fig. 2 is shown a series of sand bins with the foundry offices and washrooms over them, and in the space adjoining the sand bins the coreroom is located. There is also a special sandblast machine for sandblasting the interior of the tubes.

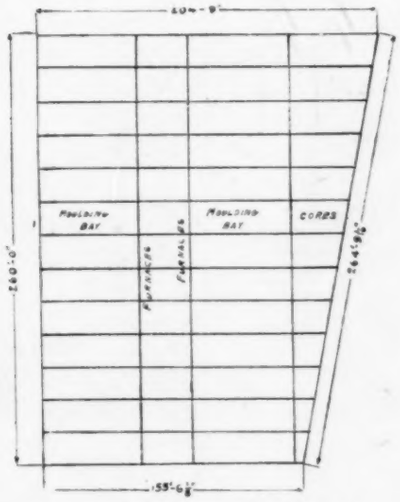


FIG. 4 APPROXIMATE FLOOR PLAN

In this construction work practically all of the steel in the old building was retained, the monitor simply being taken off and the additional steel work for the Pond truss erected above the old truss.

Fig. 2 was taken on the side of the building where the construction is entirely new, but the steel work on both sides is essentially the same.

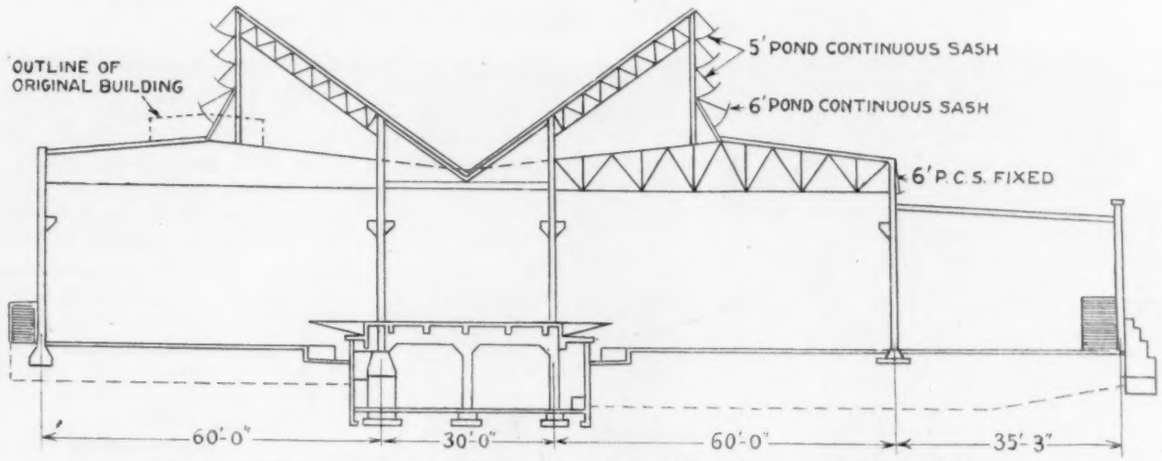


FIG. 5. SECTION SHOWING STEEL WORK OF RECONSTRUCTED CASTING SHOP

The charges for the furnaces are made up in the metal stockroom in the old building. The raw material is brought into this building on a railroad track and distributed into suitable storage bins. From these the materials are drawn for making the individual charges. A careful system of weighing and checking is followed to make sure that each batch is properly weighed up. Each batch is put into a metal box, a certain number of which make a charge for a furnace. These charges are delivered under the crane which operates over the charging platform.

The changes in this plant, including the design and supervision of erection of the new building, were carried out by The H. M. Lane Company, of Detroit, Mich. The contractors were the Levering and Garrigues Company, of New York. The ovens were furnished by Holcroft & Company, of Detroit, Mich., and the special sandblast machine by the Pangborn Corporation, of Hagerstown, Md.

Improved Wire Drawing

A Short Description of Some Improved Methods of Making Brass and Copper Wire

Written for The Metal Industry by LUDWIG WOLFFGRAM, Consulting Engineer

WIRE DRAWING

The wire drawing method for non-ferrous metals, according to my experience, can be done in the most rational (i. e. the cheapest manner and with best results as to quality of the finished materials), by employing three or more cold draws, without annealing, upon coil blocks, arranged either one in back of the other, or alongside of one another, or in back and alongside of one another.

Between each two coil blocks, which are mechanically driven, are located the die, and one or more guide coil blocks, which are not mechanically driven. The guide coil blocks are built in so as to balance the speed of the wire between each two mechanically driven coil blocks, and to prevent the wire from tearing or becoming tangled. One of these non-driven coil blocks, between each two mechanically driven coil blocks has a relative movement toward the wire, so that the latter will always remain in the same rigid position. I have found that this arrangement shows the very best results because the structure of the wire is excellent, and several cold draws can be made in between, without causing too much contraction at each cold draw. In this way breaking of the wire is not so likely to occur during the various cold draws. The contraction is measured according to the kind of material that is to be drawn and the size of the wire to be made.

Further, this working-method is the cheapest for the reason that the work is performed altogether automatically, thus affording a saving in labor expense to a great extent.

EXTRUSION

The most practical and most rational procedure—especially in connection with copper alloys and other non-ferrous metals (not pure copper), which can be turned out on extrusion presses without difficulty, is to extrude this metal instead of rolling it by various passes in rolling mills. However, the construction of the hydraulic extrusion press must be such that the diameter of the billets, treated in the press, must be in conformity with the metal which is to be finished by said presses.

It is true that a saving can be obtained in a foundry by producing billets of a large diameter, but it is of importance that the finished wire shall have considerable elongation. It is also a fact that on account of the immense contraction, which generally takes place in the presses, while producing the preliminary work for wire manufacture, when billets of too large diameter are used, that a greater capacity is obtained, but the quality of the material does not come up to the desired expectations. The fibres of the material are torn, and they do not assume the necessary longitudinal position. Furthermore, the tensile strength will be too great and too varied. The unnecessary use of excess power will cause a more rapid wearing away of the press cylinders.

Generally speaking, it is wrong to use the same size billets for all the different diameters of finished material.

Brass Melting Furnaces

A Few Suggestions for Improving the Present Construction of Crucible Furnaces

By FURNACE

It is surprising to see how little attention and study have been given to the improvement of crucible melting furnaces, particularly with that type of furnace where the crucible is removed to pour. Where melting can be done in large quantities to a charge, as in some foundry work, there are many types of satisfactory solid, liquid and gaseous fuel furnaces available, but both the rolling mill and brass foundry seem to adhere to the traditional coal and coke natural draft pit furnace, substantially the same design as that used a century ago.

Fig. 1 is a diagram of the conventional pit furnace. Well known as this type of furnace is, it is seldom designed and built properly. The relation of grate area, A, to size of flue opening, B, and to area of main flue, C, and stack diameter, is rarely properly proportioned. Dampers are seldom used intelligently and there is practically no control over the fuel burning process.

This type of furnace is by no means the only method of burning coal to heat a crucible, and of all methods

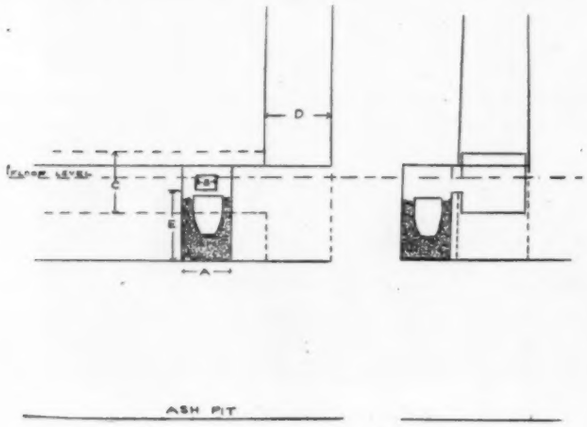


FIG. 1. TYPICAL PIT-FURNACES

it is by far the most expensive, both in cost of fuel and labor. The best grade of egg size anthracite and coke must be used and the labor of firing and cleaning grates and ashes is heavy.

Fig. 2 is a suggested type of crucible furnace. This type of furnace is a combination gas producer and furnace, and strictly speaking, gas is burned, not coal. If the size of the installation warrants the investment, or if gas can be used for other purposes in the same plant, such as in annealing furnaces, etc., the gas may be produced in a central station and piped to the furnace. This is an economical proposition, although a somewhat larger investment is required; not so large, however, as an electrical installation of the same capacity, and with the further advantage of better control over the operations and the greater flexibility of the plant. The cost per pound of good metal produced should be materially less than with any other method.

The type of furnace for burning gas which is piped to it is extremely simple, merely consisting of a chamber sufficiently large to leave about 4 inches of space all round the crucible and 12 inches head room, with proper flue connection and a small hole at the floor level to allow spilled metal to run out. The burner opening is best placed at one side and on the bottom of the chamber; low pressure air is used, at about 16 ounces. The most important feature of this type of furnace is the proper regulation of gas and air supply. Most of the cases where gas furnaces have given trouble is due to poor regulation of air and gas. Long smoky flames streaming from every opening in the furnace wastes both fuel and time; this is a frequent sight in many shops, and it would seem as though many people are not satisfied without such flames and pollution pouring from their furnaces. A good furnace tender is a crown jewel and he should be one of the highest paid men in the shop.

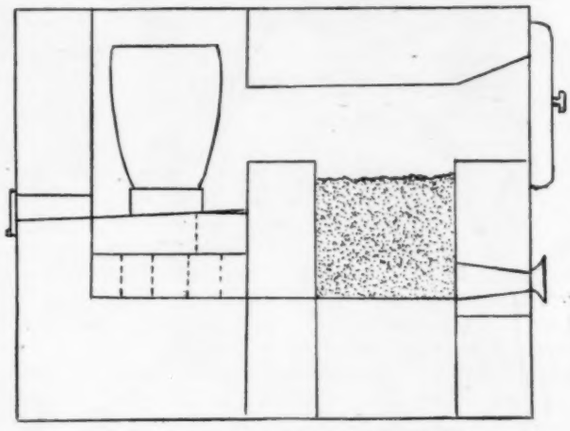


FIG. 2. SUGGESTED PIT-FURNACE

Oil fuel offers the same advantages as gas and for small installations is very convenient. The type of furnace is the same and low pressure air should be used. The type of burner is not of particular importance except that it should permit constant adjustment. The same care and attention to proper regulation of air and oil is necessary.

The advantages of a gas or oil installation are:

1. Greater production. Each fire, or furnace, will melt from 125 pounds to 200 pounds metal per hour, depending on the melting point of the alloy and the air supply available.
2. Less labor.
3. No ash treating.
4. Less metal loss on account of faster melting and cleaner working conditions.
5. Less wear and tear on crucibles.

And in addition, all the advantages of the old crucible process are retained, particularly the flexibility of plant and control of the quality. The flexibility of plant is an important advantage; small orders for copper, brass, bronze and nickel alloys can be put through simultaneously, without any changing over or expense due to operating a large furnace on a small charge.

The prospective purchaser of brass melting equipment is advised not to look for a furnace, as such; not to imagine that any one type of furnace, however new, is the solution of all his troubles. Various types of furnace melting devices are giving good service in some cases; in others they are not. The important thing is to permit careful study of the conditions by the furnace engineer, the metallurgist and the production engineer, and not only by the man who has the furnace to sell.

Between Blue Print and Production

Grand Master, Master, Plaster, Metal Plate, Split and Gated Patterns. How Made and Used

Written for The Metal Industry by WILLIAM H. PARRY

Until recently you could not pick up a newspaper or the Saturday Evening Pest, but what the word PRODUCTION was encountered, always in the sense that there had been no such animal in existence for the past four or five years, and that it was necessary to speed up matters to make up for the happy-go-lucky pace set by the mechanics during that period. However, in spite of the slackening of business production is still a factor, and always will be, as the fifty-four hour week will never be revived, and the certainty of the unpopularity of working a minute over eight hours a day is in evidence in almost every pattern shop and foundry.

W. H. PARRY

The problem of castings production can be solved only through the medium of up-to-date patterns and foundry equipment, and not then, unless the patterns are properly made so that the foundry equipment is utilized to its capacity.

The old days, when nothing was thought of the fact that one pattern was used day in and day out to make hundreds and sometimes thousands of castings, have been relegated to the rear, and now the modern match plate or split pattern plate is in universal use; and although the claim is not made here that there is anything new or startling in this state of affairs, yet for the average patternmaker, may he be ever so clever, the art of producing production patterns is not numbered among his accomplishments.

Assuming that the work at hand is of a nature that permits several patterns to be assembled on one plate the first step is the making of the grand master or master pattern and before we go any further into what promises to be a very long winded article, let us explain what a grand master and master mean.

MASTER AND GRAND MASTER PATTERNS

A grand master is a pattern so made as to allow for three shrinkages, as from it the castings are made to provide the patterns from which the match or split patterns are to be made, from which in turn the ultimate castings are to be molded. To complicate matters further, the shrinkages allowed may be for two aluminum and one brass, steel, malleable, or gray iron, assuming that the match or split pattern plate is to be of aluminum, and the first castings made from the grand master to be of the same metal.

The tendency of all patternmakers to dodge the making of grand master patterns by resorting to that hoary old method of making white metal castings from the master because white metal does not shrink, is to be deplored. The so-called white metals do shrink, and are altogether unreliable, no matter what their constituents are, yea, even with the addition of bismuth which the text books will inform you prevents shrinkage, and in fact makes the castings larger, when as a matter of exact fact nothing of the kind occurs.

Grand master patterns are resorted to when the work at hand is intricate or complicated, particularly as to the parting lines. If one grand master pattern is of such a design that a good patternmaker will take a day, week or month to make a good job of it, and a good molder will take only a day to make a half dozen or a dozen "masters" from it, then a lot of time has been saved by the molder. Again, the making of grand masters have the added advantage of trying various partings, for no matter how well planned the parting lines may have been, there are times when the addition of a little beeswax, or the scraping of the surface here and there, makes all the difference in the world.

On plain work, when a little planning will show that a wood patternmaker will make pretty close to the same amount of patterns as a molder would castings in a given time, it follows that grand masters would not be necessary, and masters would take their place. Master patterns have two shrinkage allowances, one for the plate material and one for the ultimate casting. There are of course various ways of making master patterns, and the automobile industry has been the means of stimulating some very bright minds among patternmakers in the way of making complicated patterns quickly and accurately.

PLASTER PATTERNS

The use of plaster of paris in pattern-making is as old as "Hans" Wagner and then some, but our Middle West friends use it with a lavish hand in the making of rear housings, transmission cases, and the like, by first making a "negative" in wood of the inside, and pouring plaster over it, which, when dry or nearly so, is shaved down "by guess and by gosh" until they think the desired thickness and shape is attained, which may be the case if a sufficient number of "pilot" pins have been used at essential points. But the method lacks "class" and cannot be compared with the modern method of making a "negative" or follow board of the outside, and building the pattern inside, mostly of wood, properly dimensioned, and not placed there "by guess and by gosh." The building of a pattern inside of a follow board, even if the design is such that a day may be saved by resorting to the plaster bath, is preferable in every way, by reason of its being more accurate. The follow board is on the right side of the pattern from the molder's standpoint every time.

Before leaving the plaster subject it might be well to state that it is often used on "oddside work" to form irregular partings, but is not recommended for this purpose. Patternmakers also use it on cast iron and brass die work where the material to be formed has no great thickness, or if it has, no accuracy is essential.

MATCH PLATES

Most match plates in use today are made of aluminum, not as most men think, because of its low specific gravity, or lightness as the laymen have it, but that in its molten state it flows freely, has a comparatively low melting point, and if given half a chance will present a surface as smooth as a baby's "tummy" even when ordinary molding sand is used to make the

castings. If care is taken in the selection of molding sands and "printing back" is resorted to, the surface of the resultant castings is incomparable.

SPLIT PATTERNS

Split patterns and pattern plates are usually, but not always, made when the parting line is on one plane, and it is a question very often as to whether it has any advantages over the one piece match plate cast from master patterns.

If the parting line can be made on one plane then the old method which is still in good health, means that the patterns either of wood or metal are placed on each side of the plate so spaced that enough sand can be rammed between them to stand up to the inrushing metal. The proper placing of the halved patterns, each half in its proper relation to its mate, is accomplished through the medium of dowels that have been fitted prior to locating them on the plate. In this connection great care must be exercised to drill the dowel holes at right angles to the parting joint. All accuracy is lost if this rule is not followed, as the dowel pins must either be left long enough to pass through the plate or longer ones used when doing so.

When both halves of a pattern are exactly alike, plates are sometimes made with the patterns on one side only, so spaced that the drag and cope molds when assembled will line up perfectly, and will not show a "shift" on any of the castings, but this method is not recommended, for flask pins and holes will wear, and unless provision has been made for male and female "sand dowels" as part of any plate with straight parting lines, shifts will show on the castings in a very short time.

To make a drag and cope from this type of plate means very accurate work on the part of the patternmaker as the pattern positions must be correct relatively to the flask pins and holes, else all accuracy is lost. The flasks used with plates of this type have a pin at one end and a hole at the other, so that the terms drag and cope as applied to the half molds are in a sense meaningless, as both are exactly alike and fit these terms only when assembled ready to pour. Mention has been made here of "sand dowels." While this term may or may not convey the proper meaning, it is the best at our command.

Molders who have but little faith in shaky or ill fitting flask pins when not using flasks on "flat back" work, often resort to making two or more indentations, or building up mounds with easy lines, whose side angles run from 30 to 45 degrees in or on the surface of the mold outside of the pattern space, and furthest away for gates and risers. This is done so that when the cope is rammed it fits in or over these depressions or lumps, thus providing another means of assuring correct relationship of cope to drag, regardless of flask pins and holes. Pattern plates whose parting lines are on the same plane should be thus equipped.

There are means employed to make split pattern plates other than locating the patterns with dowels, such as the center line method, the plaster system, and the use of templets, but as it would be a waste of white print paper or mere words, and as neither of the methods has anything to commend it, a description of these methods would serve no useful purpose.

GATED PATTERNS

Gated patterns are still used, and are being made by people who do not appreciate, or do not know, and sometimes we think that they do not want to know, what match plate patterns will do in the way of production. By gated patterns is meant a number of patterns attached more or less securely to a runner through the medium of gates. It must be admitted that it was a distinct step forward over the preceding style of bedding a lot of patterns in an "odd side" and cutting the runner and gates by hand, but except in some cases where match plates or split pattern plates do not fit in, they are not in such universal use as they were some fifteen years ago.

Gated patterns are made by first finishing the individual patterns either with the gate cast integral thereto, and fastened to the runner, or soldered to the gate, the last being the very rottenest way of making them. The strongest, but not the most accurate way of making gated patterns is to make an integral casting of the whole shooting match. If one does not die of old age while filing the fins off, he will live to own a fine gated pattern, always provided that the metal used was a good red brass, as gray iron is brittle, aluminum is weak, white metal develops "the bends," and plaster is a joke. Some of the best specimens of gated work we have ever had to do with, were made of yellow birch, maple and mahogany. The runner and gates were cast of brass and let into the wood patterns. In these instances it would have been the height of folly even to consider the making of match or split pattern plates, which only proves what an "ornery" and contradictory business the pattern game can be at times. To get the best results from gated patterns it is necessary to use a follow board or "odd side" to form the partings.

Nowadays many gated patterns are attached to vibrator frames so that molding machines can be utilized in the production of castings, and the results are excellent. There are two kinds of vibrator frames in use that we know of, both patented, and pirated, as they should be, as they were in use years before patents were granted to the alleged inventors. Both of these devices slip over the flask pins, and have vibrator lugs as part of them. By their use gated patterns can be made to produce a glorious day's work if properly fastened to the frame of the one and lugs of the other.

MOLDING METHODS

The matter of actually casting the aluminum match plates so that when cast, but little remains to be done to them, has been purposely omitted heretofore, as it is an art in itself, and will be of more interest possibly to the molders than to patternmakers, though it should not be so. Once it is determined as to whether the ultimate castings are to be made on "side floor" or "bench" and the flask dimensions are agreed upon, it is necessary to provide a flask big enough to make the match plate casting, the flask pins and holes of which must fit without play. The flask pins must be perfectly parallel, for distance of twice the thickness of hole lugs. The joints of the flasks should be "out of wind." Not that the actual joint is made on their surfaces, but that it insures better all around work in the end.

Match plates are made to fit the flasks in use, be they two, three, or four pin creations, which means that that many pin lugs are to be cast as part of them, in addition to the handle lugs. In many cases, however, the handle and pin lugs are one, and are cast on each end only. The patterns are jockeyed into position (and jockeying it is, believe me), either in sand or on a board; the drag flask placed over it and

rammed, turned over, and the master patterns given the "once over" many times. When it is finally decided that the partings will be all right, the cope is placed on and rammed.

The "lift off" will prove only that the cope lift is either good or bad, due to proper or improper partings.

Patterns in the drag are allowed to remain undisturbed until the thickness of the match plate has been provided for, either through the medium of a metal plate of the outside shape and thickness, being placed between the flasks, strips of the desired thickness being laid on the drag, or sand rammed on the surface of the drag to the thickness and outside shape of the match plate. Of these three methods the first mentioned is the most reliable, particularly if standard flasks are used, though it must be admitted that it is an expensive process as it involves pretty nice machine work to make a metal plate ¼" to ½" thick and big enough to take in even a bench flask. The sand and strip method is mostly used, and if handled by a competent molder will produce good work.

Some folks pay no attention to casting the plate to the shape and size of the flask to be used to make the ultimate castings. They just make the plate big enough to cover all outside sizes, and later hack saw or band saw the plate to shape. On stove work the match plates, especially if used on floor work are provided with hinges, if the design is such as to permit the pattern being raised from the drag in a circular path.

The thickness of match plates is determined by their size and the nature of the partings. It is not always advisable to make the plates as thin as possible, with the mistaken intention of being economical in the use of aluminum. On the other hand it is not good practice to make them too thick, as too much dependence is placed on the alignment of the flask pins.

Thick match plates are justifiable when the partings approach the perpendicular, and it is necessary to provide thickness enough at these points so that in casting the plates there will be metal there instead of atmosphere.

As allowing for thickness at the partings is a very important feature in the making of match plates, it is advisable always to make the partings as flat as possible, but, as it is not always possible to do so, the increase in its thickness is the court of last resort. Suppose for instance that the parting angle is forty-five degrees, and the plate thickness is ¼ inch, the thickness at the parting will be ⅛ inch, which, if the parting space is not too great in area will cast. But let us assume that the parting angle closely approximates seventy degrees from the horizontal, and the plate thickness is still ¼ inch, then the metal at the parting area will be less than 1/16 inch in thickness, which may cast, and again it may not, as so much depends on the area, metal temperature, sand saturation, and pouring head. Better by far increase the thickness of the plate to ⅜ or ½ inch than to attempt the extremely difficult operation of soldering "cold shut" holes on aluminum match plates.

CONCLUSION

In conclusion it is well to consider the important element of shrinkage, as shrinkage rules, be they of wood or metal, are not infallible and cannot be depended upon to allow for the proper contraction in metals of any structure. So much depends on the sections being light or heavy, and their relation to one another, in the same pattern and casting, that judgment, which is acquired only after years of experience, is the safest medium to use.

How often it happens, even after the best planning, that a casting does not come up to expectations, and is over or under size, or warped out of all semblance to the pattern. Our fellow craftsmen, the stove patternmakers and "pattern fitters" have this end of the game down pretty fine, and leave nothing to chance.

True it is, that stoves from the nature of the work do not have to be so very accurate as to exact dimensions, but, as the castings must assemble with but little machine work being wasted on them, it follows, that to compete for the trade the castings must be right, and to make them so, a casting is made from the master, used as a pattern, and again cast, before even attempting to make the match plate so as to be fairly sure as to what will happen to the ultimate casting. Admitting that this is a tedious process, especially on rush jobs, yet it pays in the end as the old adage "The More Haste the Less Speed" is still in force, and applies particularly to the gentle art of making "Grand Master," "Master," Plaster, Match Plate, Split, and Gated Patterns.

Hardness of Rolled Brass

By L. J. KROM

Q.—Will you kindly tell us how various tempers such as ½ number or 2 numbers, etc., hard are arrived at in rolling mill practice? Is the rule governing the tempering of brass dependent upon the formula that "the percentage of reduction is the expression of the initial thickness minus the final thickness, divided by the initial thickness and multiplied by one hundred? Suppose, for instance, we wish to finish No. 20 metal, 2 numbers hard. At what gauge should we finish roll?

A.—The rule that you mention as a method for determining how much to roll down brass in order to make it one, two, three or four numbers hard is not applicable to your problem. This rule is applied simply to determine the percentage of reduction and your conception of it is correct, it being as follows:

The percentage of reduction is the expression of the initial thickness minus the final thickness divided by the initial thickness and multiplied by one hundred.

The foregoing rule has no connection with example that you give. The degrees of hardness of brass are determined as follows:

ON A BROWN AND SHARPE GAUGE

The reduction of two numbers is known as half-hard.
The reduction of three numbers is known as three-quarters hard.
The reduction of four numbers is known as half-hard.
The reduction of six numbers is known as hard.
The reduction of eight numbers is known as spring brass.

Now taking up your number problem, if you want to make .02" or No. 24 brass two numbers or half-hard, you would give the metal the last anneal at .025" or No. 22. In other words you would roll the No. 22 brass two numbers, making it finish at No. 24 without annealing.

Practical Foundry Mixtures

Formulae Taken From the Note-Book of an Old Foundryman

Written for The Metal Industry by F. W. LOLL

[In this notebook which came into our hands we found the formulae just as they were used in his shop. We have left the nomenclature just as he had it. Additional mixtures will be published in our succeeding issues.—Ed.]

BABBITTS AND BEARINGS

Babbitt Metal

Tin	12 lbs.
Antimony	1 "
Copper	½ "

Babbitt Metal

Tin	10 lbs.
Antimony	1¼ "
Copper	1 "

Admiralty Special Babbitt Metal

Tin	83 lbs.
Copper	8 "
Antimony	9 "

Magnolia Metal

Lead	80 lbs.
Antimony	15 "
Tin	5 "

Magnolia Anti-Friction Metal

Lead	80 lbs.
Antimony	15 "
Tin	5 "
Bismuth	4 oz.
Graphite	8 "
Aluminum	4 "

Axle Bearing Metal

Copper	10	10½ lbs.
Tin	2¼	2 "
Zinc	¼	

Locomotive Bearings

Copper	4 lbs.
Tin	7 oz.
Zinc	1 "

Strong Bearing Metal

Copper	1 lb.
Tin	3½ oz.
Nickel	2¼ "

Heavy Work for Engines

Copper	10½ lbs.	
Tin	1 "	9 oz.
Zinc		5 "
Lead		4 "

Engine Bearings

Copper	7 lbs.
Tin	13 oz.
Zinc	¼ "

Tough Metal for Engine

Copper		6¼ lbs.
Tin	1 lb.	15 oz.
Zinc		15 oz.

Babbitt Metal

Tin	86 lbs.
Antimony	8 "
Copper	4 "

Babbitt Metal

Tin	15 lbs.
Antimony	1¼ "
Copper	1 "

Babbitt Metal

Tin	12 lbs.
Antimony	1¼ "
Copper	1 "

BRASSES

Red Brass

Copper	8 lbs.
Zinc	1 "

Nice Red Skin Brass

Copper	87 lbs.
Zinc	5 "
Tin	5 "
Lead	3 "

Star Brass

Copper	1 lb.
Zinc	4 oz.
Tin	¼ "
Aluminum	¼ "

Tube Brass

Copper	60 lbs.
Zinc	40 "

Metal for Brazing

Copper	2 lbs.
Zinc	1 oz.
Lead	1 "

SPECIAL BRASSES

Alabata Metal

Copper	20 parts
Zinc	16 parts
Nickel	3 to 4 parts

Delta Metal

Copper	59
Zinc	40
Phos. Copper	0.2 to 1.7
Manganese	1
Iron	0.2 to 1.0

Gilding

Copper	4 lbs.
Brass	1 "
Tin	1 "

Gun Metal

Copper	2 lbs.
Zinc	8¾ oz.
Lead	5 "
Tin	5½ "

Mold Metal Mixture

Lead	4 lbs.
Zinc	2 "
Tin	2 "
Copper	2 oz. to 1 lb.

Ounce Metal

Copper	80 lbs.
Zinc	5 "
Zinc	5 "
Lead	5 "

Pattern Metal

Copper	1 lb.
Zinc	6 oz.
Tin	½ "
Nickel	½ "

Pump Bushings

Copper	62 lbs.
Zinc	37 "
Tin	1 "

Pumps and Chambers

Copper	8 lbs.
Zinc	1¾ "
Tin	1 "
Lead	1¾ "

Red Tomfue

Copper	10 lbs.
Zinc	1 "

Rivet Metal

Copper	1 lb.
Zinc	1 oz.
Tin	1 "

Stuffing Boxes

Copper	11¼ lbs.
Zinc	12½ oz.
Tin	7 "

Stuffing Box

Copper	90¼ lbs.
Zinc	6¼ "
Tin	3½ "

Turning Metal

Copper	1 lb.
Zinc	4½ oz.
Lead	1½ "

Cock Metal

Copper	20 lbs.
Lead	8 oz.
Litharge	1 "
Antimony	3 "

Monel Metal

A Summary of the Properties, Methods of Melting and Casting, Uses, Handling and Working in Up-to-Date Practice, of This Natural Nickel Alloy in Two Parts. Part I.

Written for The Metal Industry by ADOLPH BREGMAN, Managing Editor

Although The Metal Industry has from time to time published descriptions of various phases of the handling of Monel since its first appearance, the practice has advanced so that it was thought worth while to bring the information together under one head.—Ed.

One of the most interesting, and, in many ways remarkable alloys, which claims the attention of the metallurgist and manufacturer today is Monel Metal. Its name, which gives no clue to the composition, is that of the first president of The International Nickel Company, Mr. Ambrose Monell. In Sudbury, Ontario, Canada, where Monel metal is mined are bodies of ore containing both nickel and copper, in such large quantities that the question of finding ore and developing the mine never existed. At first it was intended to mine this material for the copper in the ore. It was later found that there was nickel present which could be economically and commercially separated and refined and for which a demand arose. It was also found that it was possible to reduce the ore without trying to separate the nickel from the copper, and to produce at once a natural alloy of nickel and copper. This alloy was named Monel metal.

The average composition after refining is approximately as follows:

Nickel	67
Copper	29
Iron	2.5
Manganese	1.5

In addition there are fractional percentages of cobalt, silicon, sulphur and carbon, etc.

PROPERTIES

Carbon affects Monel metal rather strangely. It is claimed by those who refine it, that up to 0.3 per cent increases its strength. Greater amounts cause difficulty in forging while graphite carbon makes forging impossible. Sulphur, as can easily be understood, is injurious. This applies both to the sulphur left in it from the original ore, and to sulphur picked up from coke or oil in refining.

The tensile strength is about the same as .35 to .4 carbon steel, that is from 34 to 42 tons per square inch. The elongation varies from 35 to 50 per cent. The Brinell hardness of hot rolled bars runs from 160 to 190.

Decided softening is obtained by annealing to between 1,450° F. and 1,800° F. Annealing should take place in a closed iron box. The metal should be placed in charcoal to prevent oxidation. It is very interesting to find that there have been no cases of season cracking.

One of its properties that makes it very useful for special work is its strength at high temperatures. At 700 degrees Fahr. its strength is within 5 tons of normal, which makes it very valuable for use with steam valves, turbines, etc. Its strength at high temperatures makes it harder to forge than any other non-ferrous material, and the forging must be done between 900 and 1,100 degrees centigrade. Care must be taken not to exceed 1,100, as the metal shows a tendency to crumble. In heating or melting it is necessary to use a low sulphur fuel and to watch flame conditions closely, so that the heat is as close to neutral as possible. A most important point is that the metal should be heated uniformly throughout, and this is much more difficult than with other metals, because of the low conductivity of Monel. If a forging of high strength is required the work should be finished at a temperature of 500 to 600 degrees centigrade.

The present situation of Monel metal in the minds of foundry and metal workers in general is a very peculiar one. It has in many places a bad reputation, because of the numerous failures in their attempts to cast and work it successfully. The average brass foundryman, after finding out that Monel metal has a fair percentage of copper, decides that it ought to be a simple proposition and proceeds to cast in the same manner as he casts brass. At once he strikes snags, and, after a period of difficulties, drops Monel metal in disgust and advertises the fact to his friends.

As a matter of fact Monel metal is difficult to cast. It is much more sensitive to oxidation, has a higher shrinkage, and demands a much larger percentage of metal in the gates and risers. It must be kept carefully covered and must be deoxidized before pouring. These difficulties are gradually being overcome, however, through the education of the foundrymen. Nevertheless, it is still a problem, and one on which there is surprisingly little material published. The International Nickel Company, through its subsidiary, the Monel Metal Products Corporation, is using the latter plant as a service station and as a center to which foundrymen can go for advice and information. The object is to familiarize them with the use of Monel metal and to give them the benefit of their own experience.

PRACTICE OF MONEL METAL PRODUCTS CORPORATION

The procedure followed in this plant is in general not very complicated. In particular, however, it consists largely of taking great care and pains to make sure of the fine points. The metal is received from the refinery of the International Nickel Company, in the form of pigs. It is melted in an oil fired furnace of special design,* and construction, of which there is little written. The oil which is used as a fuel, is placed in flat pans extending the full width of the furnace. These flat pans of oil are ignited and the flame drawn into the furnace, through a slit a few inches high (which also covers the full width of the furnace), by means of high stack which produces the draft. Between the melting chamber and the stack is a dust chamber which collects a large part of the dust which would ordinarily be carried off. The arch of the furnace is so constructed as to deflect the flame down on to the bed of metal, and although considerable time is consumed in heating up the furnace, a very high temperature is obtained. The furnace holds 6,000 pounds and turns out one charge per shift under

*See THE METAL INDUSTRY, April, 1916, p. 177.

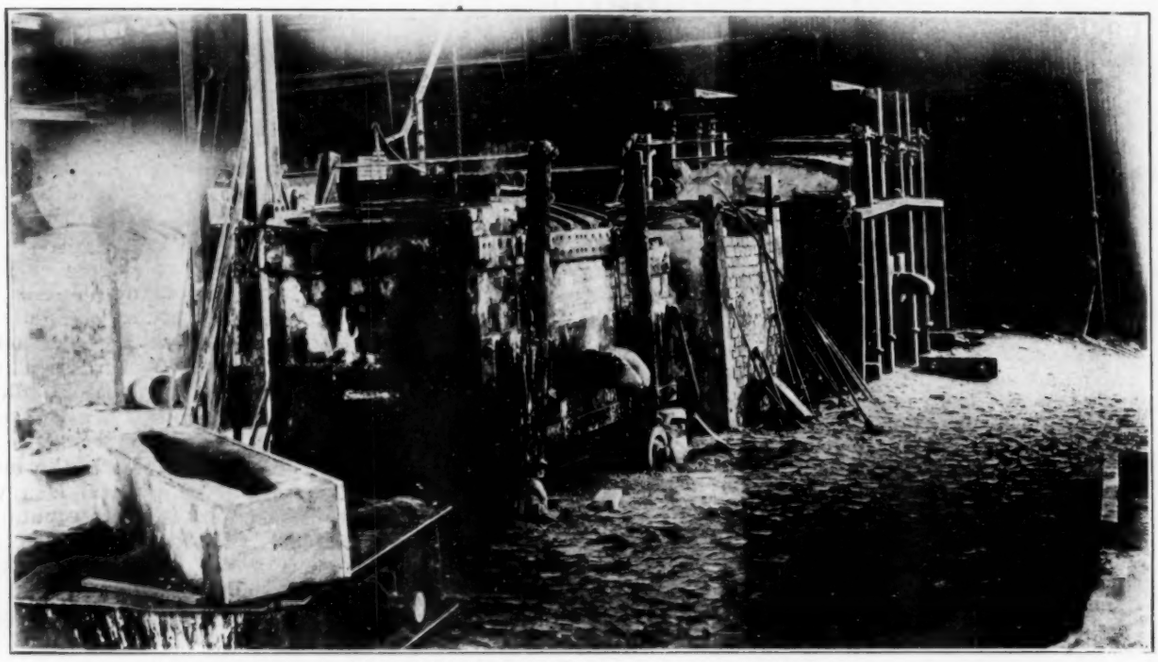


FIG. 1. NATURAL DRAFT OIL-BURNING FURNACE

ordinary running conditions. The total oil consumed is about 1,000 gallons, but a large part of this is used in preheating the furnaces.

One of the advantages of this remarkable furnace is the fact that it can be torn down and re-built within two days, without any difficulty. The arch is composed of rows of brick which are bound by steel clamps with an eye at the top. These clamps can be removed by means of a hook through this eye, taking with them one complete section of the arch. New brick are placed in the same manner.

It is necessary, while the metal is melting, to protect it from oxidation and to keep it well covered with slag. It is tapped in the usual manner, that is by drilling a hole through a clay breast. From the furnace it is poured directly into the molds, but before pouring it is deoxidized with magnesium.

Another important point is the control of the composition, that is keeping the carbon, silicon, iron and sulphur within their proper limits. Carbon can be inserted in various ways, but it is often a difficult job. Sometimes it can be managed by placing charcoal with the charge in melting, and other times it is necessary to place the carbon in a container and then to insert this container into the metal with the closed end up. Care must be exercised, however, because an excess of carbon is undesirable. Silicon is generally picked up from the furnace. It is not necessary to eliminate iron, as iron in the proportions in which it occurs in the natural alloy is not injurious; it should not exceed 3.5 per cent. Sulphur, of course, must be avoided.

In this plant a large part of the melting is done in a Snyder electric furnace, which does excellent work. This furnace is of the direct arc type, with a single electrode inserted at the top, the spark travelling between this electrode and the metal.

Part 2 will be published in our February issue.—Ed.

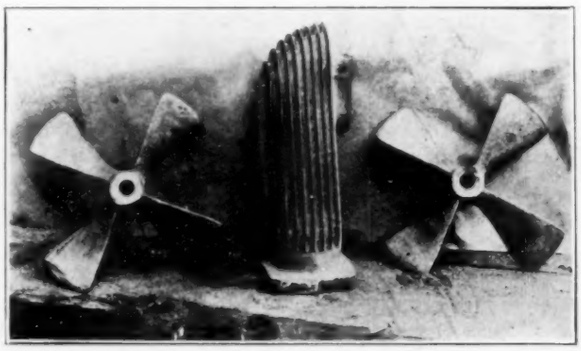


FIG. 2. SOME MONEL METAL CASTINGS

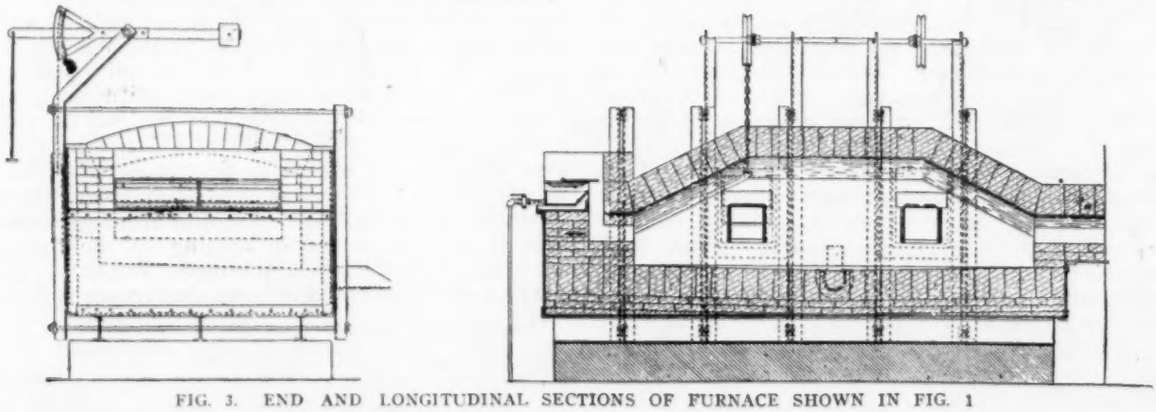


FIG. 3. END AND LONGITUDINAL SECTIONS OF FURNACE SHOWN IN FIG. 1

The Inspection of Brass Goods

An Explanation of the Need for Maintaining an Inspection Department in the Brass Manufacturing Plant

Written for The Metal Industry by P. W. BLAIR, Mechanical Editor

ADVANTAGES OF INSPECTION DEPARTMENTS

The question of inspection of brass goods in the process of manufacture has begun to interest the management of brass manufacturing plants, no matter what their line or product is composed of. The great variety of ways in which inspection brings about a saving requires the closest study of each individual case, as often the saving is made in such a way that it cannot be expressed in terms of money value.

The reader can imagine himself either the dealer or consumer, whichever the case may be, and have delivered to him goods of faulty construction. Their defects do not develop until installed or in use a very short time, and the goods have to be replaced by others of a competitor at an enormous expense. Or, on the other hand, the manufacturer of brass rod, tubing or sheet brass may have returned to him certain parts of his shipment in rods and tubing that have developed cracks or splits at certain points, after they have given a guarantee that the goods would be first class and free turning.

There are some brass manufacturing concerns which give an unconditional guarantee with all goods they manufacture. There is one concern that furnishes a printed bond in every package of brass goods, and great confidence is placed in this concern's product by dealers and consumers, as it is almost certain to supply the brass goods as ordered or represented in any preliminary negotiations. Their goods are thoroughly inspected in the course of manufacture from foundry to the finished product.

Practically all large brass manufacturing companies have grown from small concerns, and, to keep up-to-date, have had to face the necessity of instituting inspection systems at one time or another. If they have not, it does not take them long to find out that it has to come.

There is one large brass concern I have in mind that has neglected inspection in manufacture and has been endeavoring to improve their product by an expensive manufacturing system, thinking that it would take care of inspection, and they have failed. They have found out that if they had started with an inspection system in course of manufacture, they would have shown increased profits and eliminated unnecessary expenses and returned goods.

As long as the plant is small there is little or no use for an inspection department as such, but when it becomes necessary to expand the organization so that the shops become specialized, that is when certain parts are set aside for carrying on certain operations only, it immediately becomes necessary to introduce inspection to prevent one specialized department from passing inferior or spoiled work to the next department. It also prevents disputes between foremen over inferior or spoiled material, creates fair and clean competition between departments, and assists the management in locating any trouble which may be found to exist in the product. If a bonus, premium or piece-work basis is carried out the inspection department should pass on the quality and quantity of the employees' output.

When inspection is carried out along these lines it becomes the element which overcomes the detrimental factors of the specialized plant, and as specialization is the key to successful operation of the large factory, inspection may be rightfully claimed as the keystone.

WHERE INSPECTION IS NECESSARY

The question may arise at what point should inspection start. The answer is, where the castings have their origin. Start the inspection of all cores before using in the molds, and all castings when shaken out of the molds so that any defects can be discovered and remedied right at the start, and not overlooked until the castings are finished or the order is completed. Before any inspection is started a very careful study of the product should be made with a view to determine in what quantities the product will be made, the extent of identical part production and the accuracy to be obtained.

Inspection of each casting should be made after core sand is removed, the gates cut off and the castings delivered to storage. It will prevent any machining operations from being performed until the defects are discovered. By following this process, defective core work, shifted and defective castings can be eliminated to a large extent. All the rejected castings for the day are returned or a report furnished to the foundry, giving the reasons why they were rejected. The foundry is then enabled at once to correct the trouble.

PRECAUTIONS

In factories where the bonus or premium plans are operated the production and inspection department employees must be carefully controlled, as unfair decisions may result, since the rejection of parts means a loss to the man making it.

The inspector should exercise great care in the start of each operation and give his O. K. only after a dozen pieces satisfactory have been finished. He can then hold the operation up to the maximum limits until the job is completed. The rejected material should be sent to a salvage department and an effort made to salvage it; if this cannot be done, it must be scrapped and charged up to the department which made it.

Precautions should be taken that no parts enter the stock rooms except through recognized channels, in order to prevent rejected material from gaining access to a place where it will enter into the regular product as first-class material. Almost every factory purchases raw material and also semi-finished products. If the factory is of any consequence at all the purchasing agent or stockkeeper has not the time to inspect the material he buys, nor is it usual that he is capable of telling whether the material he has purchased is satisfactory or comes up to the dimensions he has specified. His business is that of a buyer, not a mechanic or an inspector. It is therefore somebody's business to see that the material purchased is what is ordered. The incoming material inspector must know the requirements of the material he is to inspect and he must know it in time to make any special arrangements or provide any special equipment. He should therefore be supplied with a copy of the purchase order and complete specifications covering the material to be purchased. Payments on purchased material should not be made until the material is approved by the inspector, a space being provided on the receiving record. When this method is followed it avoids all friction, unnecessary correspondence and sometimes even litigation, as the trouble has been discovered at the correct time and not months after, when the material was to be used.

There are a number of manufacturing concerns making lines of brass goods that make a specialty of advertising the amount of hydraulic pressure to which they submit their product before leaving their plant. This is only a minor consideration. The main point is, have they the quality of metal in their product to stand this pressure for a certain period; is the product first class in other respects, with full threads and correct dimensions? There has been such large quantities of goods placed on the market made of low grade scrap brass that the dealers and consumers are now after quality goods from high grade metals which has stood a course of inspection during their manufacture.

FITTING THE INSPECTION DEPARTMENT INTO THE ORGANIZATION

There is a broad variety of ideas as to the relation of the inspection department with the other departments of an organization. Some advocate that it should come under the factory's control and still others advocate that it should be an independent organization with its line meeting the others at the general manager.

Some companies have gone so far as to provide a separate organization under the direction of the inspection department whose duty it is to plan and prepare the best and most economical way of inspecting and testing both the parts and the completed article. To my mind it should be under the factory manager or president of the concern. The factory manager is superior to the factory superintendent, and by placing the head of the inspection department on a strong footing, any differences that come up will have to be settled by a really responsible person.

Regardless of his line of responsibility the inspector must be willing to co-operate fully with all department heads which he may be called upon to serve. Any lack of willingness to assist, on the part of the inspector, makes him a dangerous link in the chain of a factory's organization, and in such cases he should be removed even though it sacrifices inspection for a time, as in such a case he quickly becomes a worse menace than the entire omission of the inspection department. Convincing the foremen that the inspector is willing to co-operate with them in raising the quality of the product is of first importance in a factory, where harmony is to prevail between the production and inspection departments.

After the goods are assembled and turned over to the testers who are under the full control of the inspection department, they are given a thorough working test, and if approved turned over to the finished equipment inspection section where the polishing, buffing and nickel plating inspection takes place. All rejected material is returned to the department responsible for the fault for which it has been rejected. A rejection tag is made out by the foreman inspector describing in detail the reasons for the rejection, and attached to the material before its return. The department responsible for the trouble investigates the reason for the rejection with a view to reclaiming it. If it can be fixed up it is corrected and returned to the inspectors for approval. If it cannot be reclaimed and is an assembled part the good parts are removed and returned to stock, and the bad parts scrapped.

Inspection of parts manufactured in large quantities is a comparatively easy matter, as in such cases it is profitable to make gauges of the go and not go type. Such special gauges, with a little patience exercised in training the personnel, permit the employment of unskilled female labor, thus reducing the cost of inspection.

Casting Sleeves

Q.—I am making some sleeves as per sketch and occasionally get a good one. The castings are made in dry sand, on the side as the patterns are in halves, then blackened with lead and molasses water mixed as a wash, then put in core oven and thoroughly dried. The mold is taken out, core put in, closed, stood on end and lowered into pit; runner made up in green sand and cast, running it with pop gates on top and casting with flanges down. The metal is all new and the mixture is straight 88 copper, 11 tin, and 2 zinc. The metal is melted in oil furnaces and no crucibles in furnace. The castings look as though the metal was burnt.

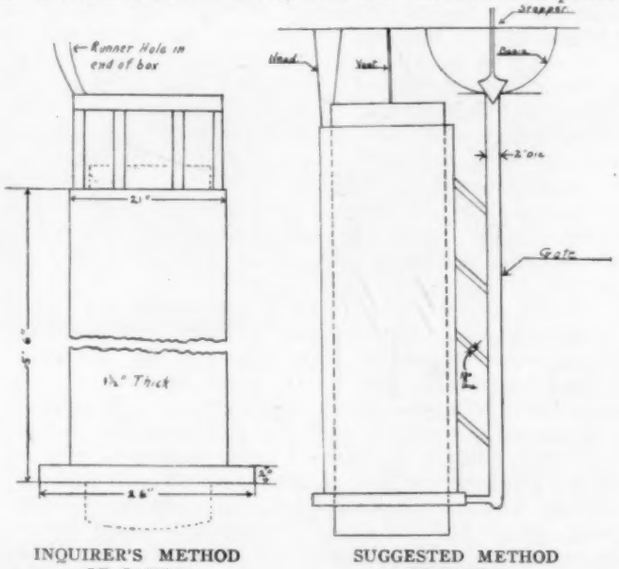
A.—I am not quite sure as to what the trouble is. It looks as if you had done an excellent job of molding. However, I do not favor the dropping of the metal down through the pop gates to the bottom of the mold as the metal strikes the core, separates into small balls and rolls into the flange.

I would suggest you make your mold in the same manner as you have been doing, with the exception that you run your gate from the bottom as per enclosed sketch.

This method will give you an even flow of metal as it enters the casting. Make a pouring basin large enough to hold most of your metal, placing a plug in the gate hole and when the metal is most all in the basin, pull the plug and let the metal into the gate from the bottom. Place a riser on the opposite side of the runner to let the air escape; the pressure that is formed.

I assume that you use an open grade of sand. I would suggest that you rub your core with black lead, wet with carbon oil, which will give you a smooth casting inside.

When melting the metal, melt the copper first, get good and hot and add ½ pound of 15 per cent. Phosphor Copper. Stir in the tin a little at a time and when all charged let it stand a few minutes, then add the zinc and pour.



INQUIRER'S METHOD OF GATING SUGGESTED METHOD OF GATING

If you use bad castings or gates, I would suggest that you do not use over 50 per cent. gates and add the same amount of Phosphor Copper per hundred pounds charged and your results should be O. K. even though your melting may not be perfect.—W. J. Reardon.

Bronze Die Castings

The Development of the Industry of Casting Bronze in Metal Molds

Written to The Metal Industry by HUGH R. CORSE, General Sales Manager, Titanium Bronze Company, Niagara Falls, N. Y., and CHARLES PACK, Secretary and Chief Chemist, Doehler Die Casting Company, Brooklyn, N. Y.

Statement by Mr. H. R. Corse

We have read with great interest your editorial on "Bronze Die Casting," page 520, Vol. 18, No. 11 of your paper, and from your last paragraph I thought that perhaps I could write you something along this line which would be of interest, since we made die castings here successfully for three or four years and discontinued them not because we could not make them satisfactorily but we did not see a sufficiently bright future in the department to justify expansion.

We went ahead with this proposition when we had found that we could make the castings satisfactorily, but we did not realize how much they would cost us per pound. We later found that the price which we ought to get was prohibitive in most places, although we could die cast to the accuracy of commercial machine work, but unless six or seven rather expensive machining operations could be saved the piece was not economical.

With regard to the material for the dies, I might say that we overcome this difficulty and that some pieces were produced in lots of 50,000, and I believe we could easily get from 20,000 to 25,000 castings from the same dies. Of course, if the detail in the die was fine, such as in threads, to which Mr. Jeacock refers, the life of the die

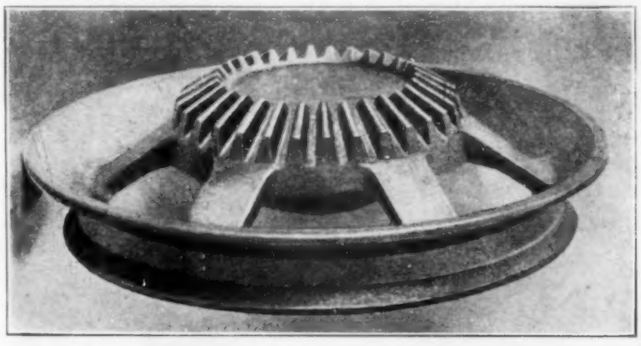


FIG. 1.—TYPICAL BRONZE DIE CASTING MADE BY TITANIUM BRONZE COMPANY

would be much shorter. This would also be true of such pieces as the bevel gears we show in our center page, but a material was found which we used satisfactorily for over two years for such dies.

Without being familiar with the experience of the Doehler Die-Casting Company, I might say, for your information, that there was a man, who was originally working for a small company in Kenosha, Wis., which I believe was the pioneer in the field of die casting aluminum bronze. This concern after a time broke up and he went with the McGill Manufacturing Company, of Valparaiso, Ind., probably seven or eight years ago, and this company has been making die castings of aluminum bronze successfully ever since.

This man later came with our organization for a short time and left to go with a Detroit concern. After he left us we put on a tool and diemaker and as superintendent of this department developed the work to the point shown in our booklet. Upon the expiration of his contract he associated himself with a concern which soon became known as the Buffalo Bronze Die Cast Corporation, and I believe that the statement Mr. Jeacock makes is reliable except that I could not check his experience with regard to casting fine threads.

I am not familiar with the aluminum die casting process. The bronze die casting concerns to which I have referred use a still more simple process and the pressure of gravity only, but it is entirely practical, excepting that it is not as cheap a process as might be desired. However, it is my personal opinion that this product could be advertised and quite a wide market developed for pieces which would justify the prices that we found to be necessary.

It is my understanding that the Doehler Die-Casting Company, of Brooklyn, and the Stewart Manufacturing Corporation, of Chicago, both of which concerns turn out bronze die castings, use an alloy not unlike manganese bronze or Muntz metal, in other words, a high grade yellow brass, and although it has a similar color to aluminum bronze this alloy is, as you will recognize, entirely different from aluminum bronze. I am also convinced that the method of handling the metal in the molds is entirely different. When you consider that aluminum bronze has excellent wearing qualities and remarkable resistance to vibration, it becomes apparent that it fills a different field from that of the other metal.

Some of the castings we made were for automobile windshield parts, which are subject to a great deal of vibration. It is my opinion that if engineers were familiar with the properties of this metal and the possibilities of this process, and would design pieces from this standpoint, as many of our customers did, they could well afford to pay the prices that we found were necessary.

Please understand that we have practically discontinued this department and do not contemplate developing it further. However, in reading over your article I could not help but be interested in it, and thought that perhaps some of the above information might interest you. I would like to repeat that we did not discontinue the work because of failure to make the castings, but because we did not readily find a market for them at the prices which we charged. I see no reason why a concern that was prepared to develop this field could not build up a nice business, although it would probably be widely distributed.

Perhaps one reason why the concerns who have successfully made aluminum bronze die castings are not more generally known is that a very few customers take almost their entire output, so that they do not solicit new business, with the exception of Mr. Jeacock's company.

Evidently the Doehler Die-Casting Company is not familiar with the material that these aluminum bronze die casting companies use for their dies and have started out with a brass having entirely different foundry characteristics, so that although both companies make yellow metal die castings the comparison ceases there.

If the above enables you to reconcile the statements of these two gentlemen I shall be very much pleased.

Statement from Mr. Charles Pack

Mr. Thomas W. H. Jeacock, in a letter written to, and published by the Iron Age, and noted in your editorial, "Bronze Die-Casting," page 520, vol. 18, Nov., 1920, takes exception to statements made by me in a paper on "The Relation of Die-Casting to Foundry Practice," read before the American Foundrymen's Association in Columbus. Mr. Jeacock does not specifically point out the objectionable statements in my paper, but says:—

"Mr. Pack makes the assertion that the casting of brasses and bronzes in metal molds, is an impossibility and is not being done practically at the present time."

Mr. Jeacock then proceeds to describe some remarkable achievements in the casting of aluminum bronze. He says "We have accomplished the coring of holes, with metal cores, to a degree of accuracy of plus or minus one-half thousandths of an inch on holes one-half inch in diameter and as deep as one and one-half inches."

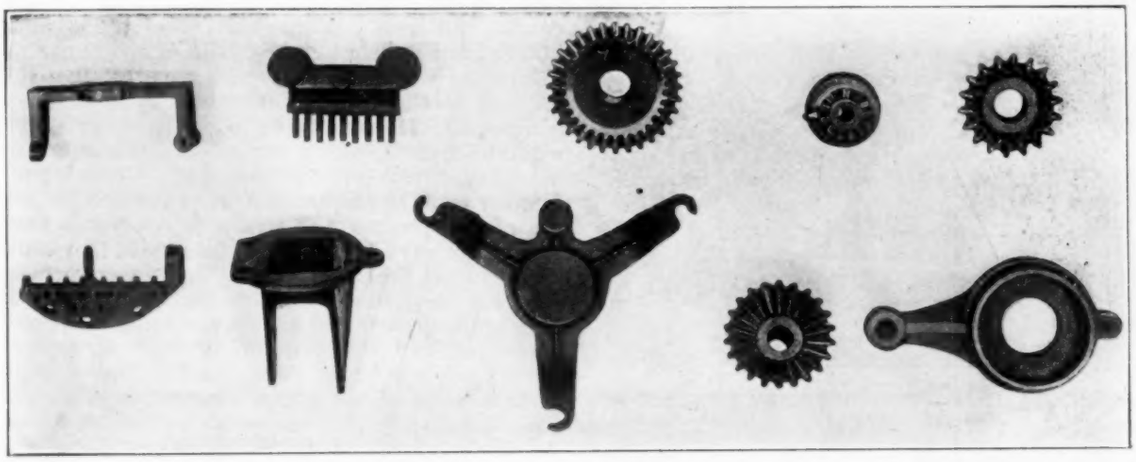
Having carefully read the statements of Messrs. Jeacock and Corse on the subject of Bronze Die-Casting, I find no occasion to modify or retract any statements made by me before the American Foundrymen's Association. I have never claimed that brass or bronze castings could not be produced in metal molds. It is a well-known fact that cast iron fittings are being produced in metal molds on a large tonnage basis. This, however, would not justify the claim that the die-casting of cast iron is a perfectly feasible process. Similarly, the fact that some companies are producing a number of comparatively simple aluminum-bronze castings in metal molds, does not justify the claim that aluminum bronze can be die-cast "to a degree of accuracy of plus or minus one-half thousandth of an inch."

It may be well to have a clear definition of "die-casting" before attempting any discussion of this subject. In a paper read before the American Institute of Metals, and published in the METAL INDUSTRY, November, 1914, die-castings were defined as "metal castings, made by forcing molten metal, under pressure into a metallic mold or die." This definition, I believe, is descriptive of "die-castings" as the term is understood in the industry.

Mr. Jeacock does not state whether his product can be classified under this term as here defined. However, Mr. Corse in his candid and interesting statement, states that the "pressure of gravity only" is used in the processes referred to, by him.

It may interest you to know that during the past twelve years, the Doehler Die-Casting Company has made every effort and spent large sums of money in an attempt to develop the process of casting brass and bronze in metal molds, with or without the external application of pressure. Systematically co-ordinated experiments are being carried on in our three plants at the present time to improve the quality of our die-materials. The cause of die failure has been carefully investigated. The success of the process for die-casting aluminum and its alloys, is based mainly on this development work on die materials carried on in the Doehler laboratories.

Aluminum-bronze has been die-cast by the Doehler Company as early as 1909. I submit to you herewith ten separate and distinct aluminum-bronze die-cast parts produced by the Doehler Die-Casting Company during the period of 1909-1912 inclusive. These castings were produced in quantities and shipped to our customers for use in magnetos, carburetors, adding machines, locks, automobile steering wheels, etc. You will note that various types of bevel gears were cast, holes as small as ⅛-inch diameter were cast, and in one part, nine steel pins were cast in place. These castings were not cast "to a degree of accuracy of plus or minus one-half-thousandth of an inch." It may interest you to know that the commercial production of castings to such a degree of accuracy has never been claimed by our company for any alloy. The degree of accuracy that can be maintained on die-castings is indirectly proportional to the melting point of the alloy used. It is doubtful in my mind if any reputable die-casting company would attempt to die-cast any part in zinc or aluminum alloy "to a degree of accuracy of plus or minus one-half thousandth of an inch." The unavoidable variations in die and metal temperatures make such a degree of accuracy impossible in casting aluminum-bronze.



BRONZE DIE CASTINGS MADE BY DOEHLER DIE CASTING COMPANY, FROM 1909-1912

The process used for producing the aluminum-bronze die-castings submitted herewith was discarded together with a number of other processes tried subsequently for the reason so well stated by Mr. Corse "that the price which we ought to get was prohibitive in most places."

It is quite true that the process could be used for the production of some few parts and show a saving over other methods of production, but these instances are so few and isolated that a large investment would not be warranted.

Aluminum Alloy Pistons

An Article Covering the Advantages of Aluminum, the Alloys in Use, Their Treatment and the Design and Manufacture of the Pistons for Gasoline Motors

Written for The Metal Industry by ERNEST V. PANNELL, The British Aluminium Company, Ltd., New York

INTRODUCTION

In 1913 two or three makers of automobiles in Belgium and France adopted pistons of aluminum alloy instead of steel for their racing engines and to a certain extent for passenger car work. The first argument brought in favor of aluminum was the reduction in weight, which would reduce the kinetic energy locked up in the pistons by one half and increase the efficiency, especially at high speeds. The other advantage, which was demonstrated by test, was that the new pistons ran cooler due to their better heat conductance.

ERNEST V. PANNELL

A year later, with the advent of the war, the aluminum piston was taken up and developed for aircraft work; committees were formed to investigate the most suitable alloys and their treatment and light alloy pistons are standard for practically all aircraft engines. But although aircraft experience has been useful to the automobile engine designer, it must be remembered that the airplane is a heavy duty engine of a very special type, without the limitations of the passenger car or truck in respect of repairs and gasoline consumption.

FEATURES OF ALUMINUM

The physical properties of Gray Iron and Aluminum for piston work are as follows:

	GRAY IRON	ALUMINUM (12% Cu.)
Specific Gravity	7.80	2.89
Lbs. Per Cub. Inch	.282	.104
Specific Heat	.120	.240 (hot)
Thermal Conductivity	.111	.380 (hot)
Expansion Coeff.	110×10^{-6}	26.4×10^{-6}
Melting Point	1500°C	640°C
Shrinkage, Per Cent	1.00	1.25
Tensile Strength	17000	20000
Tensile Strength (hot)	17000	10300

Aluminum pistons are sometimes advertised as being only 40 per cent the weight of the equivalent iron; this is going too far, for if the aluminum were poured in the same mold as the iron it would weigh nearly this and adding the weight of rings to both and using the minimum casting thickness of 3/16" for aluminum it will weigh more than half the iron piston. However, by abandonng the trunk for a special design, an aluminum piston can be produced just half the weight of a light cast iron one. The following figures relate to the Ricardo pistons introduced in 1918; cylinder diameter: 4 inches:

Gray Iron (Light Model)	4.1 lbs.
Aluminum Trunk	2.7 "
Aluminum Crosshead	2.6 "
Aluminum Slipper	2.0 "

It is easily proved that thermal advantages of aluminum are best brought out where the weight is not cut too fine.

The thermal features of the two metals in the above table are figured for a piston temperature of 350° C though the cast iron will probably reach considerably higher than this. The temperature reached by the piston depends on (a) the heat generated by the gases in combustion and (b) on the specific heat and conductivity of the piston. Now on the basis of specific heat the two-pound aluminum piston will become just as hot as the four-pound iron one, because their specific heats are as two to one and their mass as one to two. But the higher conductivity of the aluminum will carry the heat away to the skirt, and the cylinder walls, three and a half times as fast and therefore it will run cooler. Two important facts arise out of this: (a) hot spots being relatively absent from the aluminum pistons, a higher compression can be used without premature firing and (b) virtual absence of carbonization yields higher efficiency and may permit of operation with a lower grade of fuel.

ALUMINUM PISTON ALLOYS

	Al	Cu	Zn	Mg	Mn	Ni	Sn	Fe	Gravity	Tensile	Elong.
Corbin	87.5	12.5	...	...	...	...	...	...	2.95	22000	...
Belgian	90.5	7.0	2.5	...	...	...	...	...	2.87	.....	...
German	93	...	...	7	...	...	...	...	2.50	27000	6
Curtiss	95.2	2.5	...	1.5	...	...	...	...	...	28000	2
Aerolite	86	12	...	...	2	...	...	...	...	22000	...
Air Board	89	10	...	...	...	...	1	...	...	20000	...
Air Board	88	12	...	...	...	...	...	...	2.89	22000	...
Air Board	85	14	...	...	1	...	...	...	...	.....	...
Benz Aviatik	80	6	12	tr	tr	...	...	1.5	...	.....	...
British	94.8	...	...	...	...	5.5	...	...	3.0	21700	9.0
Magnalite	94.2	2.5	0.5	1.3	...	1.5	...	...	2.8	26000	2.5
Magnalium	95	...	...	5.	...	...	...	...	...	22000	4.0
N. P. L.	92.5	4	...	1.5	...	2.	...	...	...	30000	2.0
Lynite, 122	88	10	...	...	.25	...	...	1.5	2.95	28000	2.5
	90	8	...	0.5	...	...	...	1.5	...	.....	...
	88.5	10	...	0.5	...	...	...	1.	...	.....	...

Early pistons were cast in the regular "run of foundry" alloys until their characteristics were better studied after which such mixtures as Lynite No. 122, Air Board L8 (12 per cent Copper) and the various Magnalium alloys were developed.

The foregoing alloys and many others were used on a commercial scale before any reasonably thorough tests were made to standardize the best mixture for the purpose and eliminate the unsatisfactory ones. This accounts for several manufacturers becoming disgusted with aluminum and returning to the use of gray iron pistons. A factor which was overlooked in the early designs was the tensile strength at high temperatures. In 1917 tests were made by the National Physical Laboratory in England with the following results (using permanent molds):

PISTON ANALYSIS	TENSILE AT 350° C
Cu: 14 Mn: 1 Sn: 1 Zn: 1	16300 lbs.
Cu: 14 Mn: 1	14300 "
Cu: 14 Ni: 2	13600 "
Cu: 14 Mn: 1 Sn: 1	13400 "
Cu: 14 Fe: 1	12000 "
Cu: 14	10700 "
Cu: 12	10300 "
Cu: 12 Ni: 2	10000 "
Cu: 8 Mn: 1	9700 "
Cu: 4 Ni: 2 Mg: 1.5	9640 "
Cu: 8	7500 "
Cu: 7 Sn: 1 Zn: 1	6950 "
Cu: 6	6900 "
Cu: 2 Zn: 15	5000 "
Cu: 3 Zn: 15	inappreciable

(Dr. A. H. Gibson of Dundee, Scotland, has found the temperature of an aluminum piston to reach 250° C and of a cast iron piston 450° C, but much higher temperatures are on record.)

It is unfortunate that these figures do not include any straight Aluminum Magnesium mixtures; however, they demonstrate that a high copper content is essential to a high temperature alloy because, although the tensile strength per se is not in question for piston work, it does afford a measure of the physical properties generally. So far as this investigation goes it indicates that a 12 or 14 per cent copper alloy yields a piston which in the words of Mr. L. H. Pomeroy, late chief designer for Vauxhall Motors, Ltd., "gives extreme satisfaction" and this has been generally recognized, especially in Europe.

TREATMENT

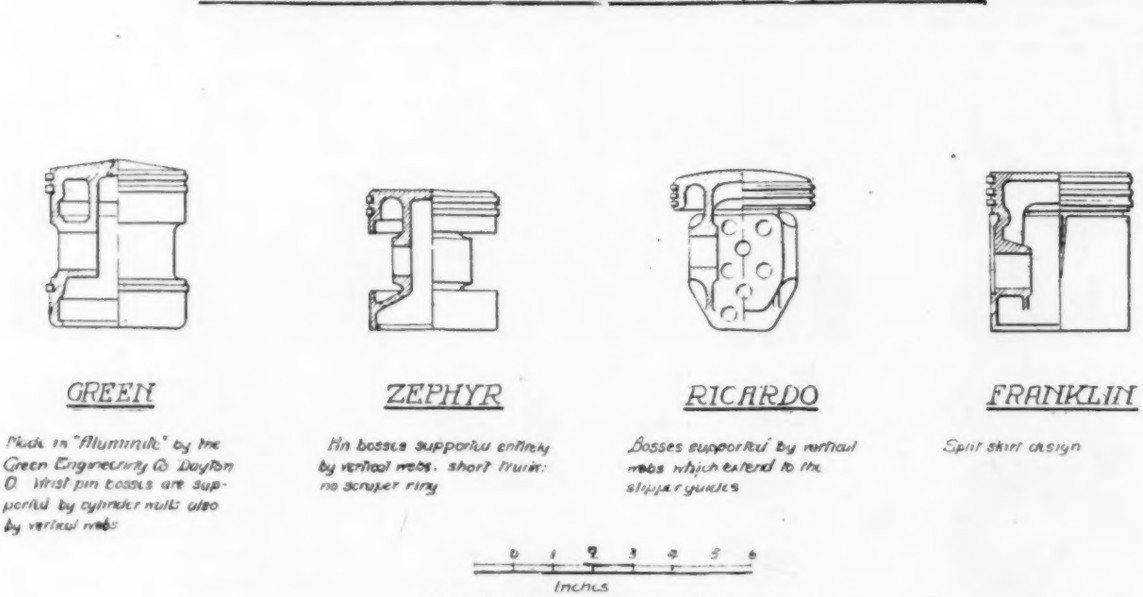
Most aluminum alloys are subject to change in shape or properties after casting and different forms of treatment have been devised to relieve the internal strains and stabilize the characteristics of the metal. When aluminum operates at a high temperature it is found not only to expand and contract when heated and cooled but also to take up a small permanent expansion, commonly termed "growth." Unfortunately this growth is not symmetrical but generally tends to ovalize the piston, distorting its cross section. It is therefore usual practice to heat, quench and age the castings, so as to eliminate this effect before the final grinding to size.

This treatment has the additional effect of increasing tensile strength hardness and heat conductivity with valuable results. These phenomena are most strongly marked in alloys containing copper and magnesium. The usual treatment is to maintain the piston, after rough turning, at 300 to 350° C in oil for four or five hours afterwards cooling slowly and finishing. When, however, castings are treated with the intention of improving their properties, it is necessary to use a higher temperature and Dr. Merica and Mr. Karr, of the Bureau of Standards, recommend for most commercial castings heating to 500° C for two hours, natural cooling and aging for several days. At these higher temperatures some other substitute for oil is frequently used and Dr. Zay Jeffries recommends fused sodium nitrate.

DESIGN AND MANUFACTURE

An experienced automotive engineer recently stated that the assumption that a piston must necessarily be of trunk design came in the same class as the argument that the world must be flat, and it is true that most designers are now getting away from the trunk piston for aluminum. Starting with an aluminum piston of regular cast iron design, one of the first troubles which European designers ran into was seizing, due to the higher expansion. Slotting the skirt in about eight places and drilling a 3/16" hole at the top of each slot, was a device adopted to remedy this and to give the skirt opportunity to take up expansion without becoming a tight fit. To a certain extent also seizing has been due to the distortion already noted and eliminated by treatment.

However, the high thermal expansion of aluminum led to considerable trouble, experiment and re-designing before it was compensated. The figures following show the increase in size and decrease in clearance for 3½"


ALUMINIUM PISTON DESIGNS (AUTOMOBILES)
GREEN
Made in "Aluminite" by the Green Engineering Co Dayton O. Wrist pin bosses are supported by cylinder walls also by vertical webs
ZEPHYR
Pin bosses supported entirely by vertical webs. short trunk: no scraper ring
RICARDO
Bosses supported by vertical webs which extend to the slipper guides
FRANKLIN
Split skirt design
0 1 2 3 4 5 6
Inches

AUTOMOBILE PISTON DESIGNS

iron piston and the equivalent in 12 per cent copper alloy. The chief lesson in these figures is their relative value for the iron piston expands no more than the cylinder, whereas, the aluminum piston expands at a much greater rate. The ultimate ideal design will embody aluminum pistons and cylinder without steel or iron sleeves; maintaining a practically constant and invariable clearance.

Cast Iron: expansion per ° C..... 11.0×10^{-6}
Aluminum: expansion per ° C..... 26.4×10^{-6}

TEMPERATURE, °C	CAST IRON INCREASE IN DIA.	ALUMINUM, INCHES
50°	....	....
150°	.0038	.00925
250°	.0076	.0185
350°	.0115	.0278

To eliminate the seizing difficulty, the next designs went to the other extreme and employed too liberal clearances. The result was that the lateral thrust on the wrist pin occurring twice in every revolution threw the piston

against the cylinder wall, first one side and then the other occasioning slap and consequent uneven wear. These effects, it will be noted, relate to the skirt of the piston where the clearance is usually least and there are no rings. According to some designers, slap troubles are reduced by using a longer skirt, especially if the wrist pin is not set too high and a scraper ring is used. A long skirt means a cool skirt and consequently it can be designed for a closer fit. Carrying the same idea further the best designs now include a means of keeping the skirt cool. Assuming that the piston will expand to a dead fit at 400° C, the following clearances are deduced for an aluminum piston working in a 3½" cast iron cylinder. Machining temperature is 30° C.

TEMPERATURE, °C	CYLINDER DIAMETER	PISTON DIAMETER	RADIAL CLEARANCE
30	3.500	3.480	.0100
100	3.503	3.486	.0085
200	3.506	3.495	.0055
300	3.510	3.505	.0025
400	3.514	3.514	....

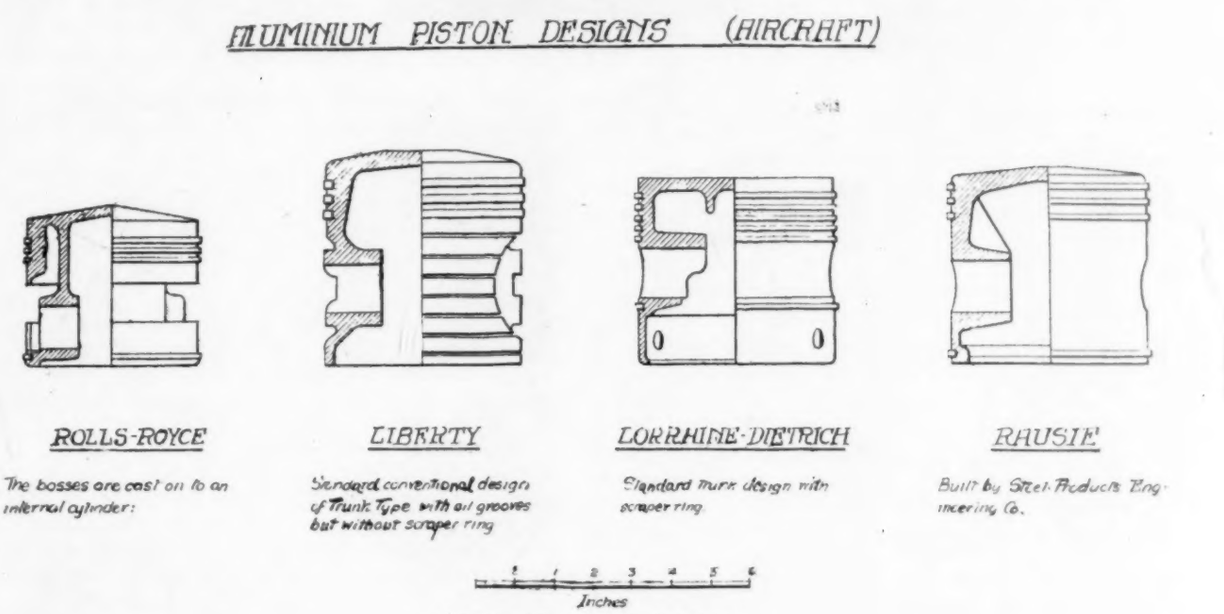
A normal clearance for a 3½" aluminum piston would be .005" to .007" at the skirt end and .010" at the head.

On the above basis this would presume a temperature of nearly 400° in the head and 150° to 200° in the skirt.

A piston having two distinct functions which are filled by the head and skirt, is best designed in two distinct parts. The head must take the pressure of the explosion and transmit it without leaking to the pin. It must also have sufficient mass to absorb and area enough to dissipate the heat evolved without becoming too hot. The skirt is merely a guide to take the side thrusts on the pin; it is therefore unnecessary for it to be a cylindrical continuation of the head. Following this argument, the Rolls Royce, the Zephyr, the Ricardo and other designs have been introduced and in the extreme case of the engines built during the war for the British Army Tanks, a piston provided with a hollow piston rod and separate crosshead were employed on the principle of locomotive practice. In the standard automobile engine, since the pin is associated in its function with the head, it should be directly connected with the head and not with the skirt. Most designers are in favor of having the pin a floating fit in the piston so that it has just to be tapped into place when cold, but with modern designs where a short pin is used, the ends are usually fixed by a lock nut. One maker using a trunk type piston fixes the pin at one end leaving it free at the other so that the piston although it expands faster than the pin will not seize upon it and become distorted.

SUMMARY

Since the aluminum piston was introduced, eight years ago, the two chief problems it presented, namely, that of a suitable alloy and a satisfactory design, have been solved. Whatever trouble is still experienced seems in every case due to insufficient attention to one of these points. Where the aluminum piston is in use it reduces inertia forces to such an extent that vibration is practically eliminated and speeds can be increased. Decreased carbonization follows the better thermal characteristics of the metal and leads to economy of fuel. Dr. A. H. Gibson in a series of tests found that the aluminum piston yielded 6 per cent greater hp. with 5 per cent less fuel; an increase in thermo-dynamic efficiency of 12 per cent.


ALUMINUM PISTON DESIGNS (AIRCRAFT)
ROLLS-ROYCE
The bosses are cast on to an internal cylinder:
LIBERTY
Standard conventional design of Trunk Type with oil grooves but without scraper ring
LORRAINE-DIETRICH
Standard trunk design with scraper ring
RAUSIE
Built by Steel Products Engineering Co.
Inches

AEROPLANE PISTON DESIGNS

Among the American automobiles using pistons of aluminum (mostly of the Lynite type) are:

Biddle	Haynes	Oakland	Cunningham
Franklin	Northway	Cole	Moline Knight
Monroe	Chevrolet	Holmes	Oldsmobile
Chalmers	McFarlane	Reo	Essex
			Premier

and of British cars, the following:

Arrol-Johnson	Hillman	Wolseley
Enfield-Allday	Vulcan	Cunard-Walker
Straker-Squire	Chalmers	Halley
Austin	Humber	Zephyr
		Rolls Royce

According to a recent report by J. E. Schipper, one-third of American automobile makers are in favor of aluminum pistons, and those makers who are achieving the most satisfaction employ designs which have been specially worked out.

The Year's Progress in Metals

A Review of the Most Important Publications in 1920, Outside of What Has Appeared in The Metal Industry

Written for The Metal Industry by C. P. KARR, Research Editor

Present Importance of Aluminum Alloys. E. H. Schulz, Naturwiss. Heft. Anon. Metallkunde, 12, 331-5. Gives the composition, usage and special properties of 25 alloys and is a continuation of the article in the same journal 12, 98-100.

Improved Aluminum Alloys. W. Fraenkel and R. Sing. Metallkunde, 12, 225-37. Discusses the most important phenomena, the mechanical properties, the occurrence of the improvement, density, specific heat and electrical conductivity.

Effect of Quenching Certain Aluminum Alloys at Different Temperatures. Leon Guillet, Jean Durand, Jean Galibourg. Revue Metal, 17, 202-15; for complete abstract see METAL INDUSTRY, Sept. and Oct. (1920), pp. 403-5.

C. P. KARR

Composition of 65 Modern Aluminum Alloys with their uses, especial properties and by whom investigated. Anon. Z. Metallkunde, 12, 98-100.

Anti-Friction Metal Substitutes. Praetorius, Motorwagen, Chem. Ztg. 44 Rep. 108.-Pb-Sn alloys containing 13-80% Pb, 6-68% Sn. 13-15.4% Sb; 25-6% Cu, when tested in a 100-h.p. Mercedes motor gave relatively good results up to a Pb content of 33% and also when the alloy contained 80% Pb. Cf. C. A. 14, 3398.

The Electromotive Behavior of Binary Alloys. R. Kreman and Robert Miller. Z Metallkunde, 12, 289-312. Discusses the electromotive behavior of Al-Hg, and Mg-Hg alloys.

The Combinations of Cu_5Sb_2; Cu_3Sb and Cu_2Sb in the Cu-Sb System). H. Reimann. Z. Metallkunde, 12, 322-31. The results of this investigation are summed up in the following 5 points: (1) A maximum of the fusion curve appears with the composition Cu_5Sb_2; (2) This eutectoidal combination splits up; (3) The omission of the peritectical structure of Cu_2Sb is explained; (4) Cu_2Sb forms frequently from the solid solution, but the occurrence is not explainable because the equilibrium curves lie too closely together; (5) Perhaps also still a eutectoid disintegration is brought about at lower temperatures.

Alloys of Copper, Zinc and Nickel. Leon Guillet. Compa. rend. 170, 460-2. A pale yellow alloy of Cu, 50; Ni 5;Zn,45%, is being used which has the following properties: tensile strength 50kg./cm²., elongation 45%, resilience ρ equal 10; hardness $\triangle$ equal 100. If the value is held between 56-62 as in the formula given in Compt. rend. 143, 1047 (1906), the resulting alloy is malleable at high temperature and has remarkable mechanical properties. Tables of the physical properties of the various Cu-Ni-Zn alloys under the different conditions are given. Lead in small amounts aids the machining. The alloys of Ni in which the per cent of Cu may fall as low as 40, and even less if the Ni is 15% show remarkable properties; tensile strength varying from 45 to 75 kg. and elongation 45 to 18%, their color goes from pale yellow to white, they are as unoxidizable as bronze, and they may be forged at fairly high temperatures. Cf. C. A. 14, 1954.

Lead-Tin-Antimony Alloys. Z. Metallkunde, 12, 70. (1) The presence of the intermediary Sn-Sb compound in this alloy makes it brittle and weak; (2) The general mechanical properties of the alloys with less than about 15% Sn is improved by addition of Sb not over 10%. The alloys in the neighborhood of this composition appear to have the best general properties; (3) Generally the increase of the Sb contents leads to an increase of hardness. However, a maximum appears to lie at 70 Pb, 10 Sn and 20% Sb. The table of mechanical properties submitted is interesting, especially as the flow line limit per square inch is among the assembled data.

Zinc Alloys with Aluminum and Copper. Walter Rosenhain, Jno. L. Haughton and Kathleen E. Bingham, J. Inst. Metals, 23, 261-317. The investigation includes in addition to a study of the constitution, work on the mechanical properties of the alloys in the cast state and as rolled, hot and cold; with and without further heat treatment. The hardness has also been investigated, both by means of the Brinell and the sclerescope tests. Aging tests have been carried out at normal temperature, both by measurements of dimension changes and by measurement of tensile strength and hardness at prolonged intervals. The rolling properties of the alloys have also been investigated and an attempt has been made to explain the anomalous behavior of some of the alloys.

Tin-Phosphorous Alloys. A. C. Vivian, J. Inst. Metals, 23, 325-60. (1) Effort was made to prepare a set of alloys containing up to the maximum amount of P. with which the Sn could be made to alloy; (2) An investigation was undertaken of the structures revealed by the microscope in the light of the cooling curves, and by means of chilling experiments, by isolations if possible and by analysis of the alloys and constituents; (3) Approximation to the temperature-concentration diagram for the series. Primary object was the interpretation of the phenomena due to the existence of conjugate solutions between certain per cent of P.

Ternary Alloys and the Coefficient of Equivalence. Leon Guillet and Albert Portevin, Rev. Metal, 17, 561-72. The ternary alloy of Cu-Al-Zn is discussed from a mathematical standpoint, showing how a point (m) within the triangular diagram of the alloy for the value $\frac{\alpha}{\beta}$ is formed by the two constituents α and β in the relation stated. The coefficient of equivalence of zinc in aluminum bronzes for the region $\alpha + \beta$ is $t = 1/6$. In the case where there are three constituents in presence of providing an invariant reaction between four phases, it can be no more the question of the isomicrographic line, if it be not opposite two of the three constituents and then the three are in agreement; the proportion of each of the constituents being then supplied by the barycentrico-coordinates (referring to the center of gravity) from the

figurative point of the alloy opposite the triangle formed by the figurative points of the three constituents in view.

Ternary Alloys of Aluminum with Magnesium and Copper. Rudolph Vogel, Z. Anorg. Chem. 107, 265-307; Z. Metallkunde, 12, 313-18. Duralumin contains on the average 4% Cu, ½% Mg and occasionally Mn. In equilibrium such an alloy must exist from solid solutions at one time homogeneous, which complete the addition dissolved in β-Al and that then under more or less complete separation of the addition and under the formation of α-Al eutectoidal crystals are split up. If the alloys from the fluid fusion are cooled quickly, then Vogel's determination supply the following course of solidification: primary unsaturated β-Al mixed crystals with strong zoning compound, subordinate outwardly to the equilibrium of Al and Al_2Cu at hand and finally the ternary combination, which by means of the reaction of the eutectic constituent Al_2Cu with the fusion has formed more or less completely. Slow heating and eventually also the simple aging at the ordinary temperature effects then the adjustment of the zones, differences in the β-mixed crystals, the desaturation of the mixed crystals, the complete removal of Al_2Cu under formation of the ternary compound and finally the absorption of the same in the mixed crystals. The eutectoidal cleavage and the recrystallizing processes still naturally join in all that.

Thallium-Tin Alloys. Paul Fuchs, Z. Anorg. Chem. 107, 308-12; Z. Metallkunde, 12, 318. The thallium-tin alloys consist of a simple mixture of both metals with a eutectic point at 70 atomic per cent. It was still to be ascertained whether the mixed crystals in the proportionate mixture of 6 to 8 = 75 atomic per cent Th., there exists a resistance limit towards chemical reagents. Such a one could not be found. It is, however, also according to the electrolytic diagram at first to be taken for granted, that the alloy with 70% atomic is not at all single phase, but consists of a quantity of tin holding α-thallium crystals with free tin.

Alloys for Technical Purposes—Hardness of the Most Important. P. Ludwig, Metal Industry, London, 16, 125-9. (From Z. ver. deut. ingen.)

Rate of Corrosion of Aluminum. G. H. Bailey, J. Soc. Chem. Ind. 39, 118-201. A definite measure of the extent to which a sample of Al has been corroded per day per 100 sq. cm. of surface, is given by the formula, $CR = (9/8)\ S + W - w$), when W is the wt. of sheet employed, w its wt. after exposure, and S the wt. of ppt. obtained from the corrosive liquid after ignition. This method has been confirmed by experimental evidence carried on for ten years. Al placed in contact with 200 cc. of N HCl at 95° dissolved rapidly. Al-alloy containing small amounts of Cu show the property of self-protection against corrosion. Cf. C. A. 14, 2610.

Aluminum, Mechanical, Properties of Sheet. A. G. C. Gwyer, Metal Industry, London, 16, 246-7.

Aluminum, Nickeling of. Leon Guillet and M. Gasnier, Rev. Metal, 17, 351-59. About the only new thing in this method is the treatment of the aluminum or its alloys to a sand-blasting operation, using a pure silica sand which passes through a sieve of 2/10 mm. mesh. This sand is applied to the metal under a pressure of 1500 grams per sq. cm.; with less pressure the results are inferior. Before the nickeling the fine particles of sand adhering to the specimen must be completely removed, either by washing or by brushing thoroughly under water with a light wire brush. Deposits 0.006 mm. thick can be readily obtained. The Al article is previously coppered to a thickness of 0.02 mm. After the sand treatment and the washing and the coppering are completed the plating may proceed as if it were a copper article.

Bells in the Making. A. Hughes, Metal Industry, London, 16, 67-9.

Boron, the Manufacture of Amorphous. Dissertation, Berlin (1916), Z. Metallkunde, 12, 68. Magnesium is found to be suitable as a reducing agent upon boric acid. The product contains, however, more than 3% Mg in the form of an insoluble boride, in addition other impurities are present such as N, Co, O, and Fe. An addition of S in the reduction with Mg furnishes the best result obtained with Mg. It reduces the N and O of the product and at the same time forms an easily soluble slag. The reduction of borochloride by H in high tension arc furnace furnishes the finest boron with only 1.2% impurity.

Brass, The Art of Casting in High Tensile. Neil J. Maclean. J. Inst. Metal, 23, 193-210. An effort was made to make a sand-cast alloy without chilling that could be depended upon to give results 50% better than Admiralty gun-metal. The alloy chosen consisted of Cu, 60%; Zn, 34%; Ni, 3%; Fe, 2%; Pb, 0.25%; Mn, 0.5%; Phosphor-tin, 0.25%; a special hardener was made of Cu, 75%; Ni, 15%; Fe, 10%. Melted in a crucible, granulated by blowing a stream of molten alloy into a filled water-tank. Special care taken to keep the Zn content constant and the pouring temperature constant. Scrap-metal from foundry scrap, leads, gates, etc., and machine shop scrap was carefully collected, melted down, the ingots analyzed and the Zn required added to keep the Zn constant. The alloy when properly melted and poured can be relied upon to give sound castings, cast in sand molds, having a breaking strength of 20 tons per sq. in., elastic strength of 10 tons per sq. in. and elongation of 15% in 2 in. Best pouring temperature was found to be 1090° ± 20° C.

Brasses, Cobalt. Leon Guillet. Rev. Metal, 17, 494. Cobalt loses its magnetism at 1159°. The point of transformation falls to about 1050° for the solution and Salmen's diagram (1907), of Cu-Co, and also Lew Konja's (1908), of Co-Zn are given. The compositions studied vary from 55-60-70 Cu, 1, 2, 3, 5, Co, and 25-29, 35-39, 40-44 Zn, illustrated by 8 micrographs. The mechanical properties are stated. The coefficient of equivalence is $^tCo = -0.1$ to -1.5. The author reaches the conclusion that Co as an addition to brass is without any particular interest industrially.

Brasses, Nickel. Leon Guillet. Rev. Metal, 17, 484. Refers to the manufacture and physical properties of Nickel brasses containing a comparatively low percentage of Cu. Alloys were found that gave a resistance to rupture of 65 kg. per sq. mm., an elongation of 20% and a resilience of 8-10 kilogram-meters; Cu, 41.1%; Ni, 16.5%; balance Zn. elastic limit 57; reduction of area 19.4%; resilience 2.5, angle of rupture 179; hardness, 255, unannealed. These alloys show a great resistance to atmospheric corrosion. Coefficient of equivalence is $Ni = -1.3$.

Removal of Internal Stress in 70:30 Brass by Low Temperature Annealing. H. Moore and S. Beckinsale. J. Inst. Metals, 23, 225-35. The first effect of low temperature annealing is a distinct increase of hardness. This hardening has been observed at all temperatures used between 100°C and 300° C. The higher the temperature, the shorter is the duration of this increased hardness. The harder the brass the lower the temperature and the shorter the time of annealing, which will cause a reduction of the hardness. Internal stress is not removed and does not appear to be appreciably reduced by annealing at 100° C for many weeks. For 70:30 brass cold worked to a Brinell hardness not exceeding 165, annealing for one hour at 275° or for rather shorter times at

slightly higher temperatures is a treatment which is generally suitable.

Some Properties of 60:40 Brass. Cecil H. Desch. J. Soc. Chem. Ind., 39, 206-11. Rods of 60:40 brass from different manufacturers gave widely different results in the machine shops. Brinell hardness is unconnected with the machining quality of a 60:40 brass. Bars annealed for 2 hours at 700° gave a clear relation between the Brinell hardness and the per cent of Zn. About 1.5% Pb is sufficient and the Sn, Fe, and Al should be reduced to the lowest proportions in good 60:40 brass for machining. Fine fibrous α crystals, separated by a comparatively small quantity of β, is the most desirable structure for machining purposes. Making the Zn content constant at 40% will attain the desired result. *Cf.* C. A. 14, 3061.

Brass Scrap and Swarf, Handling and Melting. H. S. Primrose, Metal Ind., London, 15, 492-5.

Properties of Bronze and Babbitt Bearings. W. K. Frank, Iron Age, 105, 943-6. Best pouring temperature for both Sn and Pb base is 460° at which Sn base is the most fluid. Cu-Sn matrices filled with Pb bronze are preferred as a bearing because dissimilar crystal structure provides tiny oil pockets and prevents drying of the bearings. A typical bronze contains Pb, 9.5%; Sn, 10%; Cu, 79.7% and P, 0.8%; has a Brinell hardness of 60 and a compression of 0.25 on a 1" cube with a load of 100,000 lbs. per sq. in. *Cf.* C. A. 14, 1656.

Elastic Properties of Bronze Castings. George F. Comstock. Chem. & Met., Eng. 22, 1113-8. Curves are presented which demonstrate that the elastic limits of the cast bronzes studies are nearly always found lower than the proportional limits and never higher. It is recommended that proportional limit determination should be made and used for acceptance or rejection of bronzes that are intended to resist stresses in service, instead of employing the yield point. *Cf.* C. A. 14, 2610.

Corrosion of Condenser Tubes. Guy D. Bengough, R. M. Jones and Ruth Priest. J. Inst. Metals, 23, 65-135. The present report (5th) is confined to the corrosion of condenser tubes (mainly 70:30 brass), and is a study of the practical problems of corrosion in condensers and under service conditions, employing either sea water or fresh water. It is divided in four sections. First section deals with what has been called the diagnosis of condenser tube corrosion. Second section is devoted to a consideration of certain features in the structure of condenser tubes; attention is principally directed to the presence on the tubes of a surface layer consisting of structureless and highly distorted metal. In 3rd section, the five main types of brass condenser tube corrosions are considered separately in detail: general thinning; deposit attack; layer dezincification; plug or local dezincification; water line attack. Fourth section contains an account of preliminary work on the electrolytic protection of condenser tubes.

Etching Reagents for Various Alloys. Anon. Z. Metallkunde, 12, 44-6. A list of 30 etching reagents suitable for a great many alloys, ferrous and non-ferrous.

Solubility of Lead in Tin in Solid State. Parravano and Scortecci Gaz. Chim. It. 50.I, 83-92. The authors investigated the Pb-Sn alloys independently of the temperature (25° to 175°) and of the composition. From the position of the arrest point of the conductivity concentration curve it leads to the following saturation limits of the lead crystals in tin at the different temperatures of 175°, 170°, 162°, 150°, 100°, 75°, with a corresponding weight of Sn equal to 14.5, 13.5, 12.5, 10.5, 6.5 and 5 respectively. There is, therefore, obtained a segregation line which from the end point of the eutectic mixture runs downward to a slight tin content.

New Alloy of Magnesium. E. J. Jenkins. Iron Age, 106, 193-4. The so-called Dow Metal is said to be the lightest metal known which is adapted to commercial purposes. It contains over 90% Mg and is said to possess a tensile strength of from 22,000 to 25,000 lbs. per sq. in. It belongs to the same class as the Electron alloys, and under that name is well known in Europe.

Metallurgy of Manganese Bronze. Ernest J. Davis, Foundry, 48, 109-11. Scrap carefully selected may be used as well as virgin metal. Mn and Fe may be added as Fe-Mn and scrap steel, but owing to the high melting point of the latter, an alloy of Cu-Fe-Mn with lower fusibility is better. After Mn and Fe, the required amounts of Al, Sn, and Zn are stirred in. Zn is added until a test bar cast in a chill mold shows the same fracture as a standard test bar. The more crystalline the fracture, the higher the Zn content; thus a rough means of controlling the Zn content is offered. The effect of adding other elements like Al and Fe is to replace some Zn and certain multiplying numbers showing this effect, have been calculated as follows: Al, 6; Mn, 0.5; Fe, 0.9; Sn, 2; Pb, 1. The Zn equivalent may be obtained by multiplying the per cent of each element by its number, adding the per cent Zn to the sum of these products, and dividing the result by itself plus the per cent Cu. Since the per cent Zn determines the relative amounts of α and β brass present and these determine the physical properties. A Mn brass of any desired tensile strength and elongation may be produced by adding other elements without changing the Zn content. Cf. C. A. 14, 1286.

Nickel Chromium and Other Alloys. R. M. Major, Trans. Am. Electrochem. Soc. 37, Preprint. These alloys were prepared in two Heroult electric furnaces, 2-ton capacity, 3-phase, 3-electrode type. A high temperature under non-oxidizing conditions gives high quality and great homogeneity. Nichrome is 60% Ni, 12% Cr, and 25% Fe. As wire or ribbon it is used in heating appliances up to 982°, electric resistivity is 660 ohms per circular mil-ft at 23°. It is cast for carburizing boxes, retorts, etc., and is rolled into sheets or forged into chain links operating at high temperature. Nichrome II contains 12% Fe, with higher Cr, and is used for heating up to 1090°. Kromore is 85% Ni, 15% Cr. and is recommended for use at extreme temperatures and for open-type heating units. Mangaloy is a high Ni-alloy of Mn and Fe. *Cf.* C. A. 14, 1955.

Phosphor Bronze, Testing of. L. Aitchison, Metal Industry, London, 15, 525-7.

Radiography of Metals. J. Hall Edwards, Metal Industry, London, 16, 213-18.

Standardization of Metals and Alloys. Metal Industry, London, 16, 141-3; 161-3 (from Metall u. Erz).

Electrical and Mechanical Properties of the Noble Metals. F. A. Schulze, W. Giebel, Z. Metallkunde, 12, 102-8. Refers to the alloys of Pd-Ag; Pd-Au, Pd-Pt; Pt-Ag; Pt-Au; Pt-Ir, and gives the thermo-electric force of the various alloys towards Pt expressed in millivolts; tabulated in detail and accompanied by curves showing their electrical conductivity and mechanical properties—a complete and authoritative résumé of our knowledge to date about them.

Zinc-Fuse Alloys and Their Utilization. J. Czochralski and E. Lohrke. Z. Metallkunde, 12, 145-9. The official alloy is described as containing 3% Al, 6% Cu, and balance Zn. The best method of refining the product so as to eliminate the last trace of Al, possible was found to be that of adding 14.7% K_2CO_3, 14.7% NaCl, 1.01% Barium perchlorate in percentages of the charge and the 0.9% of Al in the zinc alloy was reduced to 0.01%. The refining temperature was kept at 700°. This is certainly an interesting method of removing Al from brass or bronze scrap where such a removal is obligatory by foundry requirements.

The Application of Decoration to Art Metal Ware

An Article Which Describes in a General Way the Various Processes and Methods Used in the Decorative Application of Ornament to Art Metal Ware. Part I.—Handiwork

Written for The Metal Industry by A. F. SAUNDERS, Designer, The Benedict Manufacturing Company

This series is not written as a course of instruction but rather to explain in a comprehensive way the different processes as they have developed from the first crude scratchings of primative man in his efforts to beautify, by means of ornamentation, the various articles conceived to serve his needs, in both a utilitarian and artistic manner.

Man's first manifestations of his desire to embellish were expressed through his attempts to cut a decorative pattern on the rude implements and utensils he fashioned out of wood, bone and clay. Naturally, at the beginning, his methods of application were simple, his tools crude, and as he advanced in his discoveries of the various metals and learned how to utilize them to his growing needs, new methods and tools had to be devised if he was to continue to satisfy his desires for decoration. How long it took him to develop a tool capable of cutting a pattern on the hard surface of his bronze battle axe, we can only guess. We do know, however, that his early efforts were confined principally to methods embodying the principles of what we term engraving, he was already familiar with this art of incision through cutting his patterns on wood and bone.

Engraving on metal can be traced back to very early times, though previous to the beginning of the Christian era we have but few examples of the art to guide us in tracing out its early development.

Although engraving is one of the simplest methods of applying ornament to metal ware, it is also one of the most important, as it forms the basis of the art of carving, inlaying and some forms of enameling.

Before proceeding further, let us classify the various processes of applying decoration; they cover a wide range in the field of artistic endeavor. First in importance is handiwork, which covers all methods in which the major part of the work is done by tools guided or controlled by the mind and hand alone. It includes engraving, carving, inlaying, enameling, embossing, repoussé and flat chasing and saw piercing. Then come methods covering a combination of hand work and the use of mechanical processes to produce the effect of handiwork. They include chased castings, chased stampings, engraved stampings and etching. The third group is produced entirely by mechanical methods, such as mould castings, die stampings, machine piercing, engine turning and electro plating.

ENGRAVING

As the art of engraving is the oldest, it takes first place in describing the various methods of applying ornament. It is also the best known and perhaps the easiest understood, as the method of execution is so simple. This, however, should not be construed to mean that it is an art easy to learn. On the contrary, it is most difficult to master, requiring years of practice in handling the various shaped tools or Gravers, a steady hand, a thorough understanding of the different metals, and last, but most important, a fine sense of the artistic.

To engrave as we understand the art today means to cut in sunken patterns, with tools of highly tempered steel of different shapes and sizes, controlled by the thumb and palm of the hand, the former acting as a guide and the latter supplying the necessary driving pressure to do the cutting. As the different metals vary in hardness, a greater or lesser degree of resistance is offered the cutting tool, so the engraver must know by the feel just the right amount of driving pressure necessary to insure an even and clean cut line. The whole charm of engraving depends upon graceful, clearly defined lines. Unlike chasing, nothing can be left to the imagination. Well executed engraving possesses a certain artistic value and beauty all its own, and forms a most admirable method of decorating silver table ware, as patterns so carried out in no way interfere with the general lines or contour of the pieces they grace. This can not always be said of ornament when executed in high relief. That the master craftsmen of American Colonial times understood and appreciated the value of engraving is plainly seen in much of the beautiful silver ware that has been handed down from their day. The beauty of their work depended more upon graceful outline of form rather than ornate ornamentation.

INLAYING—NIELLO WORK

Closely akin to engraving is the art of inlaying, of which there are two forms. The first, and perhaps the oldest, is known as "Niello" work, taking its name from the old latin word "Nigellum," meaning black, as the decorative pattern appears, when finished, a most beautiful lustrous black. The process in itself is quite simple, but a most interesting one. Niello is sometimes confused with enamel, but it is entirely distinct, as enamel is of a glassy, vitreous nature, fragile and easily chipped, while niello is metallic in composition, not easily damaged, and permitting of the very finest kind of hair line decoration quite impossible in enamel or any other method of inlay.

The first step in niello work is the engraving of the decorative pattern. Clean cut lines of a uniform depth are essential, as none of the underground must show through in the final finishing. The cutting need not be quite so deep as required for enamel, but every line, however small, will show up clearly after the filling in and fusing has taken place, hence great care must be observed in cutting out the pattern. When the engraving is finished, each line is filled in with the niello, which is a prepared metallic powder, jet black in color, and composed of fine silver, copper, lead, borax and sulphur. These materials have been fused together in a crucible and when cooled reduced to a very fine powder.

After the filling in of the whole pattern with this black powder is completed, the article is placed in a muffle furnace and subjected to a gentle heat, great care being required to prevent any part of the work from becoming overheated and burning the surface, producing blotches in the finished design. After cooling, the work is carefully rubbed down with fine rotten stone until the design shows up clear in every detail, the black lines forming a most attractive contrast with the silver ground work. A final polish with rouge leaves an even, bright surface.

From remote times niello work appears to have been practiced throughout the entire eastern world. The earliest known specimens of the art have been found in the tombs of ancient Egypt, and the finest examples of niello were produced by the master craftsmen of Flor-

ence, Italy, during the fifteenth and sixteenth centuries. The art is still practiced in India today. Niello work is truly a decorative art of the highest order and is a pleasant reminder of an age when metal craftsmen were artists as well as artisans.

INLAYING—FILLING IN WITH METAL

The second and perhaps better known method of inlaying is that of filling in the cut-out pattern with pieces of metal of a different color. Like niello, this art originated in the Orient, where it has been carried to the highest state of artistic perfection. The Japanese still lead in the art of inlaying. Kyoto, the old capital, which for eleven hundred years was the heart and center of every art impulse in this Empire, still harbors several workshops where the finest kind of inlaid work is produced. From the Orient the art of inlaying spread to ancient Byzantium and then into Italy, where much of the metal work during the Renaissance period was decorated in this manner. The celebrated sword makers of Damascus adapted the art of inlaying to the decorating of their famous swords and daggers, and with such artistic success that the art, when applied to the inlaying of steel and iron, became known as Damasceening, taking the name of the city where the art was carried to such a high state of excellence.

The art of metal inlaying requires patience and a steady hand. It consists of cutting away the surface of the metal in lines and spaces bordered by undercut edges. This cutting or engraving is done with pointed gravers for the lines and broad ones for any wide spaces. These lines and spaces are filled in with strips of the particular metal used in the design; drawn wire can be used in the fine line work, but pieces of metal cut to conform with the pattern are used for the broad spaces. The ground of the space to be filled is carefully roughened all over to raise little points which give a key to the inlaid metal. The wire, or strip, as the case may be, is gently tapped into place with a flat shaped punch and a small hammer. The metal inlay strip or wire is usually made a trifle thicker than the cavity it is to fill, to allow for the spreading out of the metal under the undercut edges of the pattern, which of course holds it firmly in place. So securely does this hold the inlay in place when done properly that examples of Damasceening over three centuries old show no signs of any loosening of the inlayed parts. When the filling in of the whole pattern is completed, the surface of the articles is carefully stoned over, then polished, to give a final smooth finish.

The inlaying is usually done with a metal softer in composition than the metal used in the body of the article so decorated. For example, gold or copper inlayed on silver; gold, silver, copper and brass on steel or nickel; copper or silver on brass, etc. A variety of color combinations can also be worked out by oxidizing the metals to different shades after the inlaying is completed and the surface made smooth.

Although inlaying is a simple process, it is also very exacting, requiring much skill and time to ensure good results. Yet with all the beautiful decorative effects that it is possible to obtain with inlaying, it has been allowed, at least outside of the Orient, to become almost a lost art.

A study of the examples of inlay and Damasceening exhibited in our art museums today will give one an idea of the beauty of the art as practiced in years long past, and it should inspire our metal designers and craftsmen of the present age to emulate this fine work.

ENGRAVED DECORATION ON SILVER COFFEE SET

The next paper will describe the art of enameling, Repoussé and flat chasing, also saw piercing as done by hand.

Standardization of Tools

By means of the universal use of standardized tools which are used in the different automatic and semi-automatic screw machines, turret lathes and other machines, and by intensive study and close co-operation, the supervisors in the tool department and the factory in a large eastern brass plant have greatly reduced the number of sizes in stock of different tools, punches and dies with a correspondingly great reduction in the inventory. They have made changes in their blue prints and improvements that have led to simplified and standardized tools, have extended the use of their devices and have bettered the inspection methods. The combination of these efforts has resulted in a saving of the time needed for tool adjustment in the shop, also in a gain of the life of the tools and thus decreased the amount of tool consumption per unit of output. Where 3,500 tools were formerly required to produce 1,000,000 parts less than 2,100 are now needed. The longer life and better quality of the tools have been real factors in increasing the output per machine and reducing the cost. Equally interesting results have been secured in the shops by studies of steels, heat treatment and machining processes. The development of better cutting tools was directly reflected in the increased production of parts and the reduction in the amount of scrap. P. W. B.

Black Nickel Solutions

A Description of the Experiments Performed, and the Results Obtained in Depositing Black Nickel Without the Use of Copper, Arsenic or Sulpho-Cyanate Salts, in Two Parts. Part I.

Written for The Metal Industry by JOSEPH HAAS, Jr.*

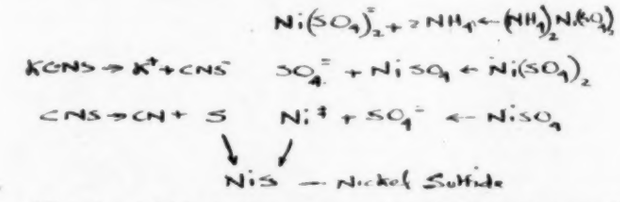
BRIEF HISTORY

The production of real black nickel deposits, that is, deposits that are not alloys such as are produced by the use of copper or arsenic salts, but simple deposits, made their first appearance about 1906. The composition of this black deposit, called black nickel, has been a matter of varied opinion, some believing it to be nickel sulphide, NiS, and others a deposit of nickel and carbon. The solution has been also said to be the most difficult to obtain uniform and constant results from. Further, a great deal of controversy has arisen from time to time over its composition. There are hardly two platers that can get the same results from identical solutions. Each varies the composition somewhat or makes a different chemical addition to intensify the blackness of the deposit.

Essentially the formula for the deposition of black nickel has remained as it was first brought out, consisting of the double nickel salt, zinc sulphate, and a sulpho-cyanate salt. At first most formulæ contained the potassium sulpho-cyanate, which was replaced by the ammonium salt and later by the sodium salt, and equally good results obtained. Other than equally good results should not have been expected, as the one that replaced the other had chemically the same properties, differing in composition only in the nature of the positive ion. The chemical formula of each is: Potassium sulpho-cyanate—KCNS; ammonium sulpho-cyanate NH_4CNS—sodium sulpho-cyanate—NaCNS. There was no reason to expect otherwise than the same results from substances so identical in composition.

GENERALLY ACCEPTED THEORY OF BLACK NICKEL DEPOSITION

It will be proper to state here the theory by which it is claimed that the black nickel deposit was formed. Upon electrolysis the sulpho-cyanate salt yielded sulphur which, in combination with nickel, yielded a black deposit, nickel sulphide—NiS. The reactions by which this deposit could be formed are complicated.


$Ni(SO_4)_2 + 2NH_4 \leftarrow (NH_4)_2Ni(SO_4)_2$
$KCNS \rightarrow K^+ + CNS^-$
$SO_4^{=} + NiSO_4 \leftarrow Ni(SO_4)_2$
$CNS \rightarrow CN + S$
$Ni^{+2} + SO_4^{=} \leftarrow NiSO_4$
NiS — Nickel Sulfide

Nickel sulphide is classed as an insoluble salt, but all insoluble salts are to a small extent soluble, and therefore some of it can exist in solution. Especially in a case such as this it would be so, because its concentration would necessarily be exceedingly small, compared to the concentration of the primary reactions. To be deposited on the cathode, the nickel sulphide would have to be positively charged. This also is possible because similar cases are known to occur.

The zinc sulphate in the formula was said to be necessary to produce a black deposit, for if it was left out only grey deposits would result. The necessity of having the zinc sulphate present was the cause of a great deal of speculation among platers, and also the cause of a great deal of trouble, because its function was not understood. It was claimed to aid in the conductivity of the solution, in order that the bath might be operated with a voltage of ½.

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AUTHOR'S THEORY

Considerable experimenting over two years has led the writer to believe that he can reveal the black nickel solution in a new light, explain the function of the presence of the zinc salt, and give two new formulæ, tried out thoroughly in actual commercial practice, both of which are radically different in chemical composition.

Preliminary experiments of various kinds which had for their purpose the throwing of light on the nature or chemical composition of the deposit will be omitted, as they are far too numerous. The following are the facts that the writer will try to prove, or are observations on the operation of black nickel solutions:

1. The black nickel deposit can be formed without the use of sulpho-cyanate salts.
2. The black nickel deposit may be any of the following, depending on the chemical composition of the solution:
   (a) Nickel sulphide—NiS.
   (b) Nickel hydroxide—$Ni(OH)_2$.
   (c) A combination of NiS and $Ni(OH)_2$.
3. A zinc salt is absolutely necessary for the production of a good black nickel, and it is that which is the cause of the formation of the black deposit.
4. An alkali salt, preferably the sodium salt, aids in the more rapid production, and in its blackness of color.
5. A theory of the function of the zinc salt and alkali salt is advanced.
6. The conditions necessary for the deposition of black nickel and subsequent results, if not adhered to, are enumerated.
7. Black nickel solutions deposit much more rapidly if operated between 80°-90° F.

The black nickel solution as originally used will first be given and commented upon. All experimenting was carried on in a six (6) gallon pottery jar, so that all precipitates and sediments could more easily be detected.

SOLUTION NO. I

Original Black Nickel Solution.

Of this solution there are two formulæ commonly in use:

Double nickel salts	10 ozs.	8 ozs.
Potassium sulpho-cyanate	½ oz.	2 ozs.
Zinc sulphate	¼ oz.	1 oz.
Water	1 gallon	1 gallon

Both of these solutions will, under the same conditions of temperature and pressure, give identical results. There is nothing wrong with either of these formulæ, and whatever trouble has been experienced in the past, is not due to the formulæ, but to the fact that those that have been using them have not known the functions of the chemicals used. The only criticism to be made is that the sulpho-cyanate salt is not necessary and is, consequently, an additional cost to the maintenance and operation of the solution. Sulpho-cyanate does, without the presence of zinc, yield a black deposit from a double nickel salt solution, as will be shown in the next section, and its use in conjunction with the new solutions to be recommended later is not objectionable, provided the operator applies the new principles brought out.

SOLUTION NO. II

As has been previously mentioned there was a great deal of speculation as to the use of zinc sulphate. Attempts were made to eliminate it. The solution resulting has given to most of those who have tried it unsatisfactory results. The writer himself believes he has obtained good results with this solution. The advantages claimed are that a higher voltage can be used to operate the solution and, consequently, it is then placed on the same level as the other plating solutions and can therefore be operated by less skillful help. The following formula gives results, but it might be frankly stated that it is not in favor among platers:

Double nickel salts	5 to 8 ozs.
Ammonium sulpho-cyanate	3 to 5 ozs.
Water	1 gallon

The deposit from this solution is at ½ volt, greyish white; 1 volt, grey; 1½ volts, black. The color of black varies, depending upon the watchfulness of the operator.

SOLUTION NO. III

It required considerable preliminary experimenting to prove that the zinc sulphate was the essential material that caused the formation of a black deposit, but when that conclusion had been reached and the theory of the formation of nickel sulphide worked out all experimenting was then carried on in an endeavor to prove that the theory was right. In the preliminary experiments it was also found that when an alkali salt was present the conductivity of the solution was much greater, so that the deposit could be formed much more quickly at ½ volt than if the alkali salt was omitted.

The first solution attempted from which results were expected was of the following composition:

Water	1 gallon
Double nickel salts	12 ozs.
Zinc sulphate	½ oz.
Sodium sulphate	2 ozs.

Results from this solution were disappointing in that the deposit obtained, while at first very black, even and beautiful, would, after working several days, become grey and brownish. Upon the further addition of zinc sulphate a black deposit was again obtained.

It had been previously noted that there was a rapid accumulation of sediment, whitish in color, in the glass jar. Having in mind the theory of the function of zinc sulphate, it was thought that it could possibly be a zinc compound. This was confirmed by a test after thoroughly washing the sediment. This zinc compound may have been precipitated through hydrolysis, or during electrolysis. Probably both played a part, as the solution while in working would take a turbid appearance. Those who have worked black nickel solutions have observed, undoubtedly, the rapid accumulation of sediment on the bottom of the tank. This sediment undoubtedly consists in the main of a zinc compound. To keep the zinc in solution another solution was made up, using Rochelle salts:

Water	1 gallon
Double nickel salts	12 ozs.
Rochelle salts	½ oz.
Zinc sulphate	½ oz.
Sodium sulphate	2 ozs.

The results from this solution were so uniform and constant that a 30-gallon solution was made, and with satisfactory results. The voltage at which the solution was operated was ½-¾ volts, with a low current density of 1 ampere per square foot. Distance between anode and cathode 3½ inches; temperature of operation 80° F. This, then, is the solution that can be used in place of the sulpho-cyanate solution. This solution is not experimental, as it has been put in commercial operation, and can be depended upon to give uniform and constant results, provided the user acquaints himself thoroughly with the function of the materials that compose the solution.

FUNCTION OF ZINC SULPHATE

It was stated that the function of zinc sulphate had frequently been questioned. Whoever advanced the first formula for the sulpho-cyanate solution originated it in one of two ways. The first was that the solution was found by accident, and the finder was satisfied to let things as they were; or the finder knew that zinc sulphate alone would deposit black nickel, and added a sulpho-cyanate salt, which did no harm and might do some good.

It is well known to those platers who have worked with zinc or die-castings that a black nickel forms upon the articles unless care is taken. Also it is well known that small zinc novelties may be colored black by boiling with slightly acidulated double or single salts. If neutral solutions are used only metallic nickel is precipitated.

In the case of the double salts the reactions to be considered are:

(1) The dissociation of a concentrated solution of the double salts $(NH_4)_2\ Ni(SO_4)_2$

$$(NH_4)_2\ Ni(SO_4)_2 = 2\ NH_4^+ + Ni(SO_4)_2^=$$

(2) The action of the acid on the zinc

Zn + acid = hydrogen + zinc salt.

(3) This evolved hydrogen—H— acts upon one of the products of dissociation, namely, upon $Ni(SO_4)_2^=$.

$$Ni(SO_4)_2 + 10H = \underset{\downarrow}{NiS} + H_2SO_4 + 4H_2O$$

nickel sulphide

In the case of the single salt the reaction would be:

$$Ni\ SO_4 + SH = Ni\ S + 4H_2O$$

The question now is to explain the formation of black nickel from a solution subjected to electrolysis. Since, in a double nickel solution containing no acid, metallic nickel would be obtained by immersion when zinc is placed in such a solution; and when the zinc is in the dissolved state, and the solution electrolyzed, black nickel is deposited, the deposit cannot be formed in accordance with the above equations for two reasons:

(1) The formula given for the solution is neutral.

(2) And if there was any acid present (it will later be shown that slight acidity does not impair a black nickel solution) there is no metallic zinc present, as the voltage used to operate the solution does not reach the discharge potential of zinc, which is 2.35 volts. That is, the solution would have to be operated at 2.35 volts, at least, to have zinc deposited, in order to react with any acid present, to evolve hydrogen to react with nickel solution according to the above reactions.

Therefore, the following is suggested as the probable theory of the deposition of black nickel. From concentrated solutions of the double salt a black nickel sulphide is deposited, because the zinc ions, upon the passage of an electric current, exert an influence upon the ion $Ni(SO_4)_2^-$ according to the following reaction:

$$Ni(SO_4)_2^- + 5Zn^{++} = NiS + ZnSO_4 + 4ZnO$$

The plausibility of this reaction can be understood in that if the discharge potential of a zinc solution is 2.35 volts and that of a nickel solution 1.3-2.0 volts, and the solution is operated between 0:5-1.0 volts, then neither zinc nor nickel can be deposited, but that which requires the least expenditure of energy will be. In this case it is nickel sulphide—NiS.

It may be of interest to give in tabular form some of the many experiments performed.

TABLE I

VOLTAGE 0.5-1.0 UNLESS SPECIFIED OTHERWISE; C. D. 1 AMPERE PER SQUARE FOOT.

Solution No.	Double Nickel Salts; Oz. Per Gallon.	Ammonia.	Zinc Sulphate.	Rochelle Salts.	Sodium Sulphate.	Sodium Chloride.	Sulphuric Acid.	Tartaric Acid.	Boric Acid.	Ammonium Sulphate.	Zinc Chloride.	Nickel Sulphate.	Remarks. Observation.
1	12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	No deposit.
2	12	Added to slight alkalinity	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.5-0.75 no deposit; at 1.0 Ni. deposit.
3	12	Added to slight alkalinity	½ oz.	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.5-0.75 Ni. S. deposited.
4	12	Strongly alkaline	½ oz.	.....	.....	.....	.....	.....	.....	.....	.....	.....	No deposit.
5	12	Slightly alkaline	1 oz.	.....	.....	.....	.....	.....	.....	.....	.....	.....	Solution clouded due to ppt. $Zn(OH)_2$, but Ni. S. deposited.
6	12	.....	.....	½ oz.	.....	.....	.....	.....	.....	.....	.....	.....	0.5-0.75 no deposit; 1.0 Ni. deposited.
7	12	.....	½ oz.	½ oz.	.....	.....	.....	.....	.....	.....	.....	.....	Ni. S. deposited.
8	12	.....	.....	.....	2 oz.	.....	.....	.....	.....	.....	.....	.....	0.5-0.75 no deposit; 1.3 Ni. deposited.
9	12	.....	½ oz.	½ oz.	2 oz.	.....	.....	.....	.....	.....	.....	.....	Ni. S. deposited quicker than in No. 7.
10	12	.....	.....	.....	.....	2 oz.	.....	.....	.....	.....	.....	.....	0.5-1.0 no deposit; 1.3 Ni. deposited.
11	12	.....	½ oz.	½ oz.	.....	2 oz.	.....	.....	.....	.....	.....	.....	Ni. S. deposited; but streaked.
12	12	.....	1 oz.	½ oz.	.....	2 oz.	.....	.....	.....	.....	.....	.....	Ni. S. deposited.
13	12	.....	½ oz.	.....	.....	¼ fl. oz.	.....	.....	.....	.....	.....	.....	No deposit.
14	12	.....	½ oz.	.....	.....	4 drops	.....	.....	.....	.....	.....	.....	Ni. S. deposit; streaked and iridescent.
15	12	.....	½ oz.	.....	.....	.....	.....	4 oz.	.....	.....	.....	.....	No deposit; nor would 3 or 2 oz.
16	12	.....	½ oz.	.....	.....	.....	.....	1 oz.	.....	.....	.....	.....	Dark stain.
17	12	.....	½ oz.	½ oz.	2 oz.	.....	.....	.....	2 oz.	.....	.....	.....	O. K. Ni. S. deposit.
18	12	.....	½ oz.	½ oz.	2 oz.	.....	.....	.....	4 oz.	.....	.....	.....	Ni. S. in centre; Ni. on edges.
19	12	.....	½ oz.	½ oz.	.....	.....	.....	.....	.....	2 oz.	.....	.....	O. K. Ni. S. deposit; nickel salts ppted.
20	12	.....	.....	½ oz.	2 oz.	.....	.....	.....	.....	.....	½ oz.	.....	O. K. Ni. S.
21	..	.....	½ oz.	½ oz.	2 oz.	.....	.....	.....	.....	.....	.....	12	Brown stains; iridescent and spotted black.

A study of the above table reveals:

1. That metallic nickel is not deposited from the solution when the difference of potential is less than one (1) volt.

2. That black nickel is deposited from the nickel solution through the presence of zinc salts; No. 7 and No. 20.

3. That the acidity or alkalinity of the solution will not effect the formation of the black nickel deposit, provided such reactions are only slight; Nos. 3, 5 and 17.

4. That it is desirable to have a neutral salt present in the solution; Nos. 9, 12 and 19.

(This article will be completed in our February number—Editor)

Metal Plating

Part 8—Silver Plating. A tabulation showing the time required to deposit a given thickness of silver with different values of current density. Also a few remarks concerning the properties, preparation and operation of silver solutions*

Written for The Metal Industry by W. G. KNOX, Associated with the Chemical Laboratory of the Western Electric Company, Inc.

PROPERTIES

Silver is without question a most valuable metal because of its many useful properties. It is white and is susceptible to being given an extremely high polish. It is soft and ductile, which permits it to be rolled into very thin sheets and to be drawn unto exceedingly fine wire. It leads all other metals in its power to conduct heat and electricity. It is not readily acted upon by sulphuric (oil of vitriol) or hydrochloric (muriatic) acids, but is readily soluble in nitric acid. It is not greatly affected by oxygen or moisture in the air, but when sulphur compounds are present it tarnishes or discolors rapidly. Silver household articles such as knives, forks, spoons, etc., are in general very satisfactory because of the excellent resistance of the metal to the action of most food products. Plated silver ware is in more general use because of its cheapness. It does not, however, last as long as the coating wears away easily.

THE SILVER VOLTAMETER

The silver voltameter has practically replaced the earlier gas voltameter and leaves little to be desired as a method of measuring the total quantity of electricity and hence the current passed in an electro-plating operation.

The solution customarily used in silver voltameters is the nitrate and with carefully regulated conditions as to composition of solution, etc., 100% cathode deposition is easily attained. If, therefore, a solution of nitrate of silver is inserted in a circuit, it will accurately record the quantity of electricity passed because a definite quantity is required to deposit a given weight of silver. The quantity of electricity represents the average current that has been passing multiplied by the time. Hence the results are obviously calculated as average currents and not necessarily the amount which passes at any given moment of the operation. An example of this may better illustrate the point. Let us assume that in 30 minutes a total weight of 7.2 grams of silver is reduced; what will to the average current passed.

In one hour at one ampere 4.025 grams of silver is deposited.

One gram of silver will be deposited in 1 hour by $\frac{1}{4.025}$ amperes.

7.2 grams of silver will be deposited in 1 hour by $\frac{7.20}{4.025}$ amperes.

7.2 grams of silver will be deposited in 1 minute by $\frac{7.20 \times 60}{4.025}$ amperes.

7.20 grams of silver in 30 minutes by $\frac{7.20 \times 60}{4.025 \quad 30}$ amperes.

Therefore the average current will be:

$$\frac{7.20 \times 60}{4.025 \quad 30} = 3.579 \text{ amperes.}$$

This calculation may be checked by the following method:

*Parts 1 to 7 inclusive were published in THE METAL INDUSTRY, June, 1919, August, 1919, January, April, June, August and December, 1920.

1 ampere for 1 minute deposits .001118 grams of silver.
1 ampere for 1 hour deposits 4.025 grams silver.
1 ampere for ½ hour deposits 2.0125 grams silver.
3.579 amperes for ½ hour deposits 3.579 x 2.0125 = 7.200 grams.

This method is usually employed in laboratories for experimental purposes and not by operators in the shop. The copper voltameter is frequently used in making current measurements in place of the silver voltameter, since it has been found that copper is sufficiently accurate and furthermore does not involve the use of the more expensive silver salt.

A brief description of the derivation of the electro-chemical equivalents of the other metal from silver was

TIME REQUIRED FOR A THICKNESS IN INCHES OF SILVER.
Calculated on the basis of 100% cathode efficiency.
Hours, Minutes, and Seconds

Current Density: Amps Per Sq Foot	Amps Per Sq Inch	.00001	.00002	.00003	.00004	.00005	.00006	.00007	.00008	.00009	.0001	.0002	.0003	.0004	.0005	.0006	.0007	.0008	.0009	.001	.002
.05	.0035	07 20	:15	:22	:30	.37	.44	:52	1:00	1:07	1:14	2:27	3.40	4:53	6:07	7:20	8:33	9:47	11:00	12:14	24 28
1.00	.0070	03 40	:07 20	11	:15	:19	.22	:26	.30	:34	:37	1:14	1:50	2:27	3:04	3:40	4:17	4:54	5:30	6.07	12:14
1.50	.0105	:02 26	.05 30	.08 40	.11	:14	:17	:20	22	:25	:28	:55	1:22	1:50	2:18	2:45	3:13	3:41	4:09	4:35	9:10
2.00	.0140	.01 50	.03 40	.05 30	.07 20	.09 10	11	:13	:15	.17	.19	:37	56	1:14	1:32	1:50	2:09	2:28	2:47	3:03	6:06
2.50	.0175	.01 28	:02 45	:04 24	.05 12	:07 30	.08 40	.10 16	12	:13	.15	29	:44	59	1:14	1:28	1:43	1:58	2:13	2:27	4:54
3.00	.0210	:01 19	:02 32	:03 45	.04 53	.06 06	.07 20	.08 33	.09 47	:11	12	.25	:37	.49	1:01	1:14	1:26	1:38	2.00	2:02	4:04
3.50	.0245	.01 03	:02 06	:03 10	.04 13	.05 15	.06 18	.07 21	.08 24	.09 27	.10 30	.21	:32	:42	:53	1:03	1:14	1:24	1:35	1:44	2:28
4.00	.0280	:00 55	:01 50	:02 45	03 40	:04 35	.05 30	.06 25	:07 20	08 15	09 10	:19	:28	:37	:46	.55	1:04	1:14	1:23	1:32	3:04
4.50	.0315	:00 49	.01 38	.02 27	03 16	:04 05	:04 54	.05 43	.06 32	07 21	.08 10	.17	:25	:33	:41	:49	:57	1:06	1:14	1,22	2:44
5.00	.0350	:00 44	:01 28	:02 13	02 57	.03 40	:04 26	.05 09	.05 54	.06 35	07 20	:15	:22	:30	:37	:44	:51	.59	1:07	1:13	2:26
5.50	.0385	:00 40	:01 20	:02	.02 40	.03 20	.04	:04 40	.05 20	.06	:06 40	:14	:20	:27	:34	:40	:47	:54	1:01	1:07	2:14
6.00	.0420	:00 37	:01 14	.01 51	02 28	:03 05	:03 42	:04 19	.05	05 37	06 12	:13	.19	:25	:31	:37	:43	:50	.56	1.02	2:04
6.50	.0455	:00 34	:01 08	:01 43	:02 16	:02 50	:03 25	.04	:04 32	05 06	05 40	:12	:17	:23	:29	.34	:40	:46	.52	:57	1. 54
7.00	.0490	:00 32	:01 03	.01 35	02 05	:02 37	.03 08	:03 40	:04 11	04 42	:05 14	.10 28	16	:21	:26	:32	:37	:43	:49	:52	1:44
7.50	.0525	:00 30	:00 57	:01 28	.01 58	:02 28	:02 57	:03 26	.04	:04 30	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	1:40
8.00	.0560	:00 28	:00 55	:01 22	:01 49	:02 18	:02 45	.03 13	:03 40	:04 08	04 36	:09 12	14	:18	:23	:27	:32	:37	:42	:46	1:32
8.50	.0595	:00 26	:00 52	.01 18	:01 44	:02 10	:02 36	.03	.03 35	:03 57	04 12	.08 24	.13	:17	:22	.26	:30	:34	.39	:43	1:26
9.00	.0630	:00 25	:00 49	.01 13	:01 38	:01 52	:02 26	.02 50	.03 15	:03 40	.04 04	.08 10	:12	:16	:21	:25	:29	:33	:37	:41	1 22
Grams Per Square Inch		.00172	.0035	.0052	.0069	.0086	0103	.0121	.0138	.0155	.0172	.0344	.0516	.0688	.0861	.1033	.1205	.1377	.1550	.1772	.3444

Atomic Weight of Silver 108
Specific Gravity of Silver 10.5
Electro-Chemical Equivalent of Silver .... .001118

Note:- Time below 11 minutes given in minutes and seconds; 11 minutes and above given in hours and minutes

TABLE SHOWING RATE OF DEPOSITION OF SILVER

given in the initial article on metal plating the in METAL INDUSTRY of June 1919.

SOLUTIONS USED FOR SILVER PLATING

A number of solutions made up from various silver compounds have been tried for electrolytic deposition of silver, but very few have offered sufficient promise to replace the cyanide now almost universally used. There are, however, a number of solutions or formulæ available for depositing silver by simple immersion. These may or may not involve the use of cyanide, but they do not really come within the province of electroplating. The coating of silver normally deposited by the immersion process is extremely thin and has little protective value; furthermore, it may have very poor adherence qualities. As a general thing it therefore may be said that deposits of silver by simple immersion, as recommended by some, are not to be recommended in connection with electro deposits. This statement, as far as the writer knows, applies to other metals as well.

For electro-deposition we will consider the cyanide solution only.

METHODS OF PREPARATION

There are several ways in which the silver plating solution may be prepared. Four of these are given herewith:

1. From silver cyanide which may be purchased from any of the reliable dealers handling platers' supplies.

2. By dissolving pure silver in a solution of potassium cyanide with an electric current under carefully regulated conditions.

3. By treating a solution of silver nitrate with potassium cyanide in definite proportions to first form silver cyanide (AgCn). This silver cyanide is then dissolved in a solution containing sufficient potassium cyanide to form the double salt of silver and potassium (AgCn—KCn); or the entire operation may be carried out in one step by adding sufficient potassium cyanide to form the double salt shown above.

4. By converting silver into the nitrate or chloride and following out the scheme described in No. 3. With all silver solutions an excess of free potassium cyanide is required; this will be discussed in a following paragraph. Either of these methods will, if properly carried out, produce a silver plating solution of excellent quality. Methods No. 1 and No. 3 may be said to be preferable because of their simplicity.

CONTROL OF SILVER SOLUTIONS

A silver plating solution may be made up containing 1, 2, 3, 4 oz. or more of metal per gallon. The 2 to 4 oz. solutions are probably more often used and experience has shown that there is considerable latitude in the amount of free cyanide which may be added to solutions containing silver within the above limits. Some authors recommend 40 to 75 per cent. of the combined cyanide. By combined cyanide is meant that cyanide which has been used to make up the double cyanide of silver and potassium (AgCn—KCn). Therefore if 125 grams of potassium cyanide was required to convert the silver into the double salt, the amountof free cyanide will be 40 to 75 per cent. of 125 grams—in other words, 50 to 94 grams.

About the only other thing to consider in controlling a silver solution is the use of a sufficiently pure anode (preferably rolled and annealed) of sufficient size to equal or slightly exceed in effective area, the area of the parts which are to receive a deposit.

CURRENT DENSITY

The current density used for a silver solution of the above strength may vary between 2 and 5 amperes per square foot of cathode or work surface. The voltage required will vary naturally with the C. D., but should not exceed 1½ volts at the tank terminals. The proper range of current density should be determined for each silver solution and every effort made to keep within the determined limits.

CHARACTER OF SILVER DEPOSITS

A good deposit of silver will have a beautifully soft white color. Sometimes good deposits will show a slight crystalline appearance, but within certain limits this form is not objectionable. Dull gray or dark deposits (generally first noticed on edges of work) indicate burning or too high a current density. The formation of the dark areas is, under proper working conditions, perfectly visible to the operator, and the only requirement is to slightly reduce the current when the white crystalline or dull white smooth deposit will again come down. The exceedingly high rate of deposition of silver (4.025 gms. per ampere hour) will give an excellent deposit in a very short period of time, even with the low currents permissible. Bright deposits are obtained by adding from time to time small amount of carbon disulphide (CS_2). The method of making up this brightener may be found in any of the text books on electro-plating.

QUICKING

This name has been given to the process whereby parts are first immersed in a mercury cyanide solution. It is primarily a step to prevent the silver from being deposited on the work by "simple immersion" and is applicable to such metals as brass, copper and nickel silver. Iron, steel, zinc and other like parts which are to be silver-plated should preferably be given a coating of copper.

STRIKING

Soft metals such as lead alloys, pewter, etc., frequently are given the so-called "strike" in a separate silver solution. The process simply involves the use of a higher current than is usually employed in plating, for a few moments to completely cover the work with a thin film of silver. It has this advantage, that it prepares the work with a ground coat of silver of good adherence and prevents, to a certain extent, the contamination of the regular silver solution with other metals.

SILVER AS A PROTECTIVE AGENT

Silver is an electro-negative metal. Its position in the electromotive series is several positions below copper and consequently when it is deposited on other metals such as iron or steel, it must be practically impervious to moisture or corrosion of the base metal will proceed at a very rapid rate. Probably many readers have noticed how rapidly some of their silver-plated knives or forks have rusted in spots where the silver deposit has become chipped or broken. The presence of the silver or copper and silver hastens this corrosion markedly. Some of the hard alloy white metals of course do not corrode as rapidly as the iron materials, but these will show pitted or etched surfaces in a short time if the silver coating is worn or chipped off.

The table for silver deposition shown herewith covers a fairly wide range of thicknesses and is applicable to most work being turned out today. For deposits heavier than .002" a simple calculation based on the figures given will be necessary. The efficiency of a silver solution is under normal conditions very high, so that a correction of 10 per cent. in the time factor should be ample to take care of any discrepancies which may occur in actual practice.

The Metal Industries

Analyses of the Present Situation and That of the Near Future in Various Metal Lines

The Metal Trades

By G. H. CLAMER, First Vice President, Ajax Metal Company, Philadelphia, Pa.

G. H. CLAMER.

The press at present is full of articles expressing the views of various writers as to the present business conditions and prophecies for the future. All manner of explanations have been given, and there is only one point on which the writers practically agree; namely, that the period of inflation is past, and that we are heading toward a more safe and sound foundation upon which to begin the rebuilding of another period of prosperity.

Recently I attended a meeting of the Board of the American Foundrymen's Association. Several guests also were present. At a luncheon held on that occasion there were fifteen gentlemen present all representing foundry interests, and each man hailing from a different section of the country, comprising the area between Nashville and Montreal, Chicago and Boston. Each man on that occasion was requested to express his views as to the present business conditions, his judgment as to the future, and as to labor and monetary conditions. All of these gentlemen, with two exceptions, stated that they were running at very much reduced capacity, that very little if any business was being booked, and that in the course of four to eight weeks unless new business came in they would be practically without orders upon their books. Those gentlemen representing concerns producing castings for the automobile industry were naturally most depressed. The two exceptions were gentlemen connected with industries having to do with water supply equipment and plumber's goods. It was the unanimous opinion that labor conditions were very satisfactory, that labor had become far more efficient and that inefficient labor had been weeded out. Not a single man stated that he, on that date (December 8), had reduced wages, but it was the general consensus of opinion that liquidation in labor would follow the liquidation in all kinds of supplies and raw materials. It was the general consensus of opinion that collections were becoming more difficult. As to the future, the date for the revival of business was placed at not later than May, 1921. It was not thought, however, that we would then be immediately launched into another great period of expansion and prosperity, but that purchasers would find that by that time prices had reached a level sufficiently low to attract them.

I have given you the above which is the summary of the opinions expressed by fifteen representative men in the foundry industry, because it is of far more value than would be my individual judgment, which concisely stated, is the following:

Several months ago we reached the pinnacle of high prices from which there was only one way out, and that was downward. Not only had all commodity prices reached a pinnacle, but the same was true of labor and money. In other words, it was the old evil, namely, inflation. It was no doubt the high cost of money, more than any one factor, that brought to a standstill building operations, building of railway equipment, railway expansion, power houses and power generating machinery, etc., that are so badly needed. A curtailment of credits that became necessary, even at the high rates, was a further influence.

The above factors, combined with the purchasing boycott, have precipitated the great slump in business in which we are now engulfed. Unlike previous depressions, however, we are not confronted with a condition of over-production in any but raw materials. The shelves are practically free of manufactured goods. A very large proportion of manufacturing equipment, railroad equipment, power equipment, and in fact equipment of almost every kind, has, for a period of practically five years, been operated at maximum tension. Opportunity for giving it the usual care and repairs has not been available. The consequence is that much of it has been worn out and needs replacement. The needs of the country for additional power due to the rapid expansion in the use of electricity will eventually call for tremendous consumption of copper.

Unfortunately, that which is true of manufactured products, namely, under-stocking, is not true of many of the raw materials, among which copper, zinc and antimony are shining examples, and in a lesser degree, tin and lead. Under these conditions I do not believe that there will be material advances in the price of these metals until such time as the manufacture of the finished goods requiring these raw materials assumes considerable proportions. Such metals are now selling at, or below, the present cost of production. Should the producers find it necessary to liquidate their stocks in order to convert them into liquid capital, prices may go even lower than they are at present. Fortunately, they cannot go much lower. I believe that after the first of the year we shall find some buyers coming into the market, and that the buying movement will slowly and steadily progress until the fore part of the summer, when we shall again be doing a fair amount of business. With the deflation, money rates will become lower, money that is now not available will be gladly offered, and the tremendous amount of money that in the past has been necessary to swing business upon the basis of inflated prices, will become available for reconstructive uses.

The Plating and Polishing Trades

By FLOYD T. TAYLOR, General Manager, A. P. Munning & Co., New York

Two facts in connection with the plating and polishing industry should be considered in attempting to judge the conditions which will exist in this industry during the year 1921.

The first is that the plating and polishing industry depends entirely upon the activities of other industries and practically nothing can be done to increase the amount of plating and polishing required except as results

from the total volume of production of articles which are polished or plated.

The plating and polishing trade is essential to many trades ranging all the way from extreme luxury to prime necessity. Comparatively few articles of metal can be sold without first having passed through the polishing or plating room or both. Articles made of wood, bone, pearl, ivory, celluloid, hard rubber, and allied substances require polishing as a finishing process.

It is thus evident that unless all trades are quiet simultaneously, the polishing and plating industry will be employed to a greater or lesser extent.

The second point is that the plating and polishing industry itself can and will respond instantly to a demand for increased production because no great length of time is required for preparation of the goods after they reach the polishing or plating room.

The question of prime importance to the industry at the moment is that of making use of the opportunity which exists for the standardization of processes, of apparatus, and of materials used in polishing and plating.

Those engaged in the polishing and plating industry should realize that the hoped for breathing spell is with us for a brief time only. Later on, when facilities are taxed to the utmost, it will not be nearly as convenient to introduce changes of apparatus or methods because such changes usually result in a temporary loss of production. Advantage, then, should be taken of the situation which now exists to analyze and study the fundamentals of this industry, reducing opinions to digested facts, and from the facts established to re-equip or rearrange, where advisable, the departments in which these finishing operations are done.

The very recent past has proved conclusively that the plating and polishing departments of most factories are not sufficiently equipped to take care of maximum production. The plating and polishing department may be the "neck in the bottle of production," since in many plants all the product must go through this department on its way to the shipping room.

The introduction of rapid plating necessitates a general readjustment of plating room equipment in order to insure a continuous flow of work through the plating department. This is evident when a time cycle study of an electro plating process is made, taking into consideration the complete cleaning, pickling, plating, rinsing and drying operations. Where formerly the time required in the plating bath itself formed a large percentage of the total time of the cycle, under modern conditions a very different situation exists. Unless these facts are recognized, and unless plating departments are rearranged with them in mind, the result will be over capacity in the plating baths as compared with under capacity in the preliminary and in the subsequent treatments.

The essentials of the plating room era, which lies just before us, are the more accurate proportioning of the equipment used in the various steps of the process, the more accurate chemical control of the cleaning, pickling and plating solutions, and the use of mechanical and electrical equipment equalling in excellence the present day standards of power apparatus.

Mysterious mixtures are rapidly being discarded, unable to maintain their mystery against simple chemical analysis, and consequently, they no longer form a lucrative source of revenue to the supplier, nor an unwieldy instrument to the user. Additional agents of merit have been disclosed, marking a real advance in the science and practice of electroplating.

Finally, the plating department of any factory should be planned with the same degree of care as is used in the equipment of all the other departments of a manufacturing establishment.

The fundamental conditions in the plating and polishing industry are sound. With the opening up of the housing situation, which apparently can not be postponed beyond next Spring; with the completion of railroad equipment now under estimate and consideration; with the re-establishment of the automobile industry on a sound basis; with the reopening of the typewriter industry; the sewing machine industry; the phonograph industry; the stove industry, and numerous others; there will be a thoroughly normal and healthy demand for polished and plated articles.

Review of Electroplating

By CHARLES H. PROCTOR, Plating-Chemical Editor

The New Year starts out with a period of depression that always follows a period of great inflation but everyone should feel that in a short time the present business depression in all lines will pass and again we shall soon find the wheels of industry turning.

The plating industry at present is at a low ebb in all lines, but the manufacturers of builders' hardware seem to be doing a fair business. The silver plating industry did well until quite late in the year and price of silver has kept a reasonable price per ounce with some ups and downs. I believe the price of silver will not stay down to any great extent during 1921.

Platinum is still the aristocrat among metals and for articles of personal adornment is on the increase. Its present price, inside of eighty dollars per tray ounce makes the metal attractive. I do not believe the price will go much lower in the jewelry line of platinum and white gold. Platinum and green gold are still very much in vogue in the regular jewelry line; the predominating finishes are light and green gold with old antique and rose finishes a close second.

The demand for articles of solid silver during the year was in many instances above normal and the electro silver plated line was unusually busy until late in October. Future conditions will depend to a great extent upon employment of labor in other lines. The demand for all types of lighting fixtures was good proving that building operations were still continuing until late in the year. The finishes were of every conceivable style from silver and gold to polychrome, and every conceivable hue in enamel finishes was used. The builders hardware and other allied lines were still producing normally late in December and the finishes and styles were practically the same as a year ago. The brush and antique brass finish were dominant factors. Silver however is being used to a greater or less extent, principally in the brush or better finish to match lighting fixtures.

The plating record as a whole during the past year can be summed up as one of slow progress. The demand for goods during the inflated period prevented any great improvements being made, the cry being for goods and more goods and no time for improvement of the methods of production. This is changed now; manufacturers in many lines are in a turmoil and a chaos; goods have been returned to them by the car load, and the majority of this product returned is in the automotive industry.

Large producers realize that they cannot expect to produce a standard product any longer by cut and try

rule of thumb methods in electro plating any more than they can do it in mechanical production which they have to standardize. This augurs well for future progress. At last the plater realizes that the basis of his art is chemistry and his solution must be maintained upon a chemical basis instead of by the fallacy of the Baumé Hydrometer. He is commencing to realize that if he desires a uniform product from his plating tanks he has got to control them electrically according to the laws of electrical control, not a dozen tanks with all types of solution with one central volt and ammeter but with one of each of these instruments on every tank.

In many plants in the Middle West the plater has as an assistant, a young graduate chemist, usually from the local high school or university, who keeps tabs chemically of all solutions by analysis each day. This is a paying proposition for the plater as well as his employer. There is no adding to solutions of an excess of materials that are not required and only constitute a waste. It pays to have these young chemists around where production will warrant it but many of our young foremen platers are taking up the study of electro chemistry themselves through the laboratories maintained by many branches of the American Electro Platers' Society and the chemical laboratories maintained in many cities by the Boards of Public Education. With the advent of several new branches to the American Electro Platers' Society it can be realized that the work of the society is welcomed by members of the craft and appreciated by them in the ever increasing branches and membership.

There were a number of patents granted during the past year covering progress in electro plating methods. A perusal of these patents would prove of much interest to all and considerable knowledge would be gained. Personally I believe that every branch of the American Electro Platers' Society should subscribe to the patent Gazette, issued every week by the patent office in Washington at five dollars per annum. It is a good investment and keeps the members posted on development of interest to them. Copies of individual patents cost only ten cents each. A committee in each branch could be appointed to investigate all patents issued covering the art of electro plating and its allied interests.

During the early part of the year the cyanide situation was somewhat precarious, due to chaotic conditions in raw materials and labor, and considerable shortage existed but during the coming year there will be ample sodium cyanide for all, some foreign cyanides appeared in the American market but they were low in quality and high in price as compared with the quality of American made sodium cyanide 96-96% cyanogen.

The review of 1920 closes with the hope and belief that the New Year of 1921 will prove a happy and prosperous one.

The Aluminum Industry

By ALUMINUM MAN

The aluminum industry has, like all others, suffered from an over demand the first part of the year and an over supply the last part of the year. The beginning of the year found all industries completely recovered from the war and embarked on ambitious and expanded manufacturing plans. The result was that many firms contracted for more material than they could absorb. This situation gave a false impression of the true status of supply and demand, the fact being with regard to aluminum that the supply of the country is undoubtedly more than equal to any normal demand. However, such a state of affairs stimulated the importation of a large amount of foreign aluminum. In spite of this abnormal condition, the contract price of the principal produced remained stationary throughout the year at 33 cents a pound. In the "open market" prices ranged much higher, at times 60 to 65 cents being obtained.

By the end of August the business depression of the country was well developed, especially in the automobile industry. Other lines soon felt the same influences. As a consequence the domestic producers have not only been able to supply their customers but have carried a large stock of ingot on hand for the last four months of the year.

All the uses of the metal have shown marked increases. Sheet aluminum for the construction of automobile bodies, aeroplane parts, tanks, vats and cooking utensils have been the largest consumers of this type of fabricated metal. Aluminum Bronze paint powder has grown in use until the domestic plants have been kept busy to fill orders. Aluminum foil, both in the plain and printed forms has also shown a substantial increase in its use. It is stated that the principal aluminum foil manufacturer is increasing its present plant for the production of foil.

The revival of general construction work has stimulated the use of electrical conductors. Consequently, there has been a good business in this commodity during the year. The aluminum cooking utensil business has been prosperous, and all evidences indicate that it will prove to be an exception to the general rule of depression. The use of duralumin mentioned in this journal last year has gradually increased so that it is being more widely applied as its good qualities become fully understood.

All plants for producing ingot aluminum were in full operation during the first part of the year.

The large rolling mill of the Aluminum Company of America at Alcoa, Tennessee, was started in August. This unit when operating full will have the largest output of any of the sheet producing plants of the Aluminum Company of America interests. The rolling mill of the same company at Edgewater, N. J., is almost completed and is about ready to be put into operation.

There have been no inventions of any marked influence in the industry during this year. The main points of interest are that the old uses have expanded and broadened until they consume the major portion of the output.

The Aluminum Company of America is marketing an alloy under the trade name of 17S, similar in properties to duralumin, in the form of sheets, rods, tubes and fabricated shapes. This same company is also installing a plant for the manufacture of collapsible tubes from aluminum. This use, which has been very successful in Europe, is expected to be even more so in the United States.

The outlook for the year 1921 is rather uncertain at the present time. The important feature, however, is that there is an ample supply of aluminum in America to take care of any demands that may be made on it, and the producing companies are in a position to supply this demand, either in the form of ingot, semi-fabricated, or fabricated forms.

THE METAL INDUSTRY

With Which Are Incorporated

THE ALUMINUM WORLD, COPPER and BRASS, THE BRASS FOUNDER and FINISHER, THE ELECTRO-PLATERS' REVIEW

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EDITORIAL

RETROSPECTIVE REVIEW OF 1920—OUTLOOK FOR 1921

1920 was a strange year. It opened briskly—more than briskly. Mills and factories were running at top speed and night shifts were common. The country had recovered from the lull after the armistice and there was an unprecedented demand for commodities of all sorts. War wages and war profits were still in force, money was plentiful and everyone was buying, regardless of cost. Prices kept on rising, wages rose, costs rose, prices rose again, then wages and cost until the "vicious circle" became a dizzy rout. There seemed to be no limit in sight. The country went mad with spending.

Suddenly the halt came. The Federal Reserve Banks raised the re-discount rates until that business was no longer profitable, and also gave orders that only necessary loans were to be made. It was time to stop pyramiding with nothing for a base. The attitude of business banks changed almost overnight from one of open-handed generosity to careful judgment of each case.

Almost at the same time the buying public, growing more and more irritated at the steadily increasing and by this time unbearable prices, stopped buying. Retailers were left, almost without warning, with enormous stocks on their hands and no purchasers. For a while they hung on, borrowing to their capacity in the meantime. Also they cancelled their orders for future deliveries. Wholesalers passed the cancellations back to the manufacturers, manufacturers to the fabricators of raw materials and the fabricators to the producers. Costs could not come down at once. Labor was high, freight rates had risen; consequently every one sat tight and waited—and borrowed from the banks.

This lasted until the banks, pressed as they were by the Federal Reserve, could lend no more and the descent began. Firms loaded with material, needing cash, had no recourse but to sell at whatever the market would bring. Once the break was made others followed and at the present time prices are still dropping.

METALS IN 1920

Quite naturally, the first to get in difficulties were the makers of luxuries, especially expensive luxuries. The automobile offered a shining mark in such a situation and could not be missed. This trade was the first to slump, and with it came troubles for the metal trades. The demand for brass and copper sheet, tubes and castings fell off badly at once. Zinc, lead, tin and antimony followed; even aluminum, one of the strongest and least competitive markets, dropped. Platinum fluctuated wildly, but its tendency is downward. Nothing holds it up but the closing of the main source of supply—Russia. Nickel has remained absolutely solid. Domestic silver has been pegged at $1 by the Government, but foreign silver has slumped since the Chinese and India demands were satisfied. Most common metals are now selling at or near pre-war prices, which is below the cost of production. This condition cannot last.

MILLS IN 1920

Only one new rolling mill of any size began operations in 1920, namely, that of the West Virginia Metal Products Corporation, Fairmont, W. Va. This mill was described in THE METAL INDUSTRY, December, 1920. A new mill was projected, however, and work is now being done on the plans. The International Nickel Company will locate a rolling mill for Monel Metal shapes in Guyandotte, W. Va., to cost $2,000,000.

Several other projects of interest were begun. The U. S. Aluminum Company built a $1,000,000 plant in Edgewater, N. J., for making aluminum goods. The Aluminum Goods Manufacturing Company, Manitowoc, Wis., bought out the Bremer Waltz Corporation of St. Louis, in June, 1920, intending to build large additions, but the work was postponed. The General Electric Company leased the old Remington Arms property and buildings in Bridgeport. The M. L. Oberdorfer Brass Company, Syracuse, N. Y., built an addition to their plant costing, together with the site, $800,000.

NEW DEVELOPMENTS

Advances in non-ferrous metallurgy continued along the same lines as in 1919. The use of electric furnaces became more widespread in foundries. Conditions in the fuel market have practically forced foundrymen to look to other methods than the ordinary fuels for the generation of heat. One or two new arc furnaces appeared, but so far no data are available on their performances. New oil-burning furnaces have also been brought out. The Wayne Oil Tank and Pump Company, Fort Wayne, Ind., has placed several models on the market and in addition has instituted a novel policy. They do not sell the furnaces alone, but only in conjunction with a correct oil-burning system which they either supply or remodel as the case calls for. Their claim is that no furnace, however good, can function properly without a properly built supply system. The Caward-Gaskill Furnace Corporation of Chicago, Ill., have also placed a new open flame oil furnace on the market with an air preheating arrangement and a new type of burner, which they claim will melt brass at the rate of 100 pounds of metal to ½ or ¾ gallon of oil.

The one outstanding new electric furnace of the year is the Ajax-Northrup, in which crucibles are used. This furnace, which was described in THE METAL INDUSTRY, May, 1920, is of the induction type with the coils surrounding the crucible. The wire forms the primary and the metal the secondary of the system. One of these installations is at present operating in the U. S. Mint in Philadelphia on silver.

Aluminum came to the front for use in aeroplanes.

Planes made entirely of metal (Duralumin) have been flying with great success, and the future seems bright in this direction. Much work has been done on the heat treatment of Duralumin and other aluminum alloys.

The Corrosion Committee of the British Institute of Metals continued its work. So far, however, the problem of controlling corrosion is far from solved. Die casting red metals is also in the distance. This problem is most interestingly discussed in this issue by Charles Pack and Hugh R. Corse (see pp. 13-14). Robert S. Anderson, metallurgist of the Bureau of Mines, is doing much to spread the knowledge of methods of cutting down losses in sand casting aluminum.

INDUSTRIAL PROBLEMS

For the first three-quarters of the year labor troubles were, as in 1919, abundant. Waterbury, for example, suffered a three months' strike. When the depression came, the situation changed, however. Labor has become much more plentiful, due to numerous shutdowns. At the present time, in the metal trades at least, there are few, if any, strikes, and certainly no large ones. So for the present quiet reigns.

However, the problems of the relations between employer and employee is no nearer settlement than it was a year ago. Under stress of hard times, labor is quiescent, but there is no indication that a revival of business will not bring with it a fresh crop of disturbances. No fundamental changes or improvements have been made, no provisions for future contingencies or difficulties. It is simply a matter of waiting for a chance to become "top dog."

Wages are being cut widely, in amounts varying from ten to twenty per cent, which the men have for the most part, willingly or unwillingly, accepted. Considerable unemployment exists, which, if anything, will heighten existing discontent. Certainly there was never a time when understanding of our greatest problem and methods of handling it were more needed.

NECROLOGY

Among the men of prominence in the metal industries who died during the past year were: James McLean, vice-president, Phelps-Dodge Company, New York; Ezra Fred Wood, consulting engineer and director of the International Nickel Company, New York; Edward Brush, vice-president, American Smelting & Refining Company, New York; Hermann Gehnrich, president, Gehnrich Indirect Heat Oven Company, Brooklyn, N. Y.; John C. Wiarda, president, J. C. Wiarda & Company, Brooklyn, N. Y.; John Booth Burrall, president, Plume & Atwood Manufacturing Company and American Ring Company, both of Waterbury; Albert Sanders Hills, treasurer, Haydenville Company, Haydenville, Mass.; James B. Law, former sheet metal manufacturer; Charles A. Weeks, inventor of the Weeks Rotating Electric Furnace; John Jeppson, Norton Company, Worcester, Mass.; George W. Oakley, president, Oakley Chemical Company, New York; Frederick A. Bennett, Bennett & Seeley, Bridgeport, Conn.; Arthur H. Hiorns, the author of a number of books on metallurgy which were known throughout the world; Prof. Alfred Kirby Huntington, King's College, London; Joseph Richard Smith, president, Waterbury Button Company, Waterbury, Conn.; George W. Shiebler, former manufacturer of silverware; Arthur Hauck, president, Hauck Manufacturing Company, Brooklyn, N. Y.; William H. Mixer, vice-president, United American Metals Corporation, Brooklyn, N. Y.; Joseph H. Baird, Baird Machine Company, Bridgeport, Conn.

OUTLOOK FOR 1921

After a year of breakneck expansion, unheard of stock dividends and general financial carousing we are now settling down to earth. It is the "morning after the night before." It is neither easy nor pleasant, and it is small comfort to be told that it is "healthy," even though we know it to be true. The public is still disaffected and will not buy what it can do without until bottom has been reached. Where the permanent, true bottom is, no one knows yet. But this we do know. Business must resume at a not distant date. The country is not suffering from over-production but "over-financiering." People will not buy now but they must, eventually, because it is not yet fashionable to go without food or clothing or to sleep out of doors. The building shortage is as acute as ever, and soon must use enormous amounts of metal. The railroads have been allowed an increase in freight and passenger rates, not out of charity but because they needed it for equipment, and although steel will come first, copper and brass will come second. The War Finance Bill has been passed over the President's veto, and whether one approves of it or not, the farmers will be helped. Their buying power, when once more active, will be a factor toward reviving business, greater perhaps than any one other. Moreover, the cessation of buying has been caused not by a surfeit of materials, nor because people have more than they need, nor by their poverty (for the country is not poor), but by a desire to buy at the best price. When the public is assured that the time is ripe buying will re-commence and we shall see a sane, sensible resumption with good times in the near future.

Europe is far from being on her feet. It will be some time before she can feed and clothe herself. Our enormous crops, too much for us to consume, will find their proper outlet there. Also other products, in spite of the adverse rate of exchange must be obtained here. It is true that there are large stocks of metals on hand. Nevertheless, the electrical trades (which have been holding up better than any other) will continue to take copper and the resumption of building will call for brass, zinc and lead. Newspapers and books are still being read and will continue to demand type metal. Finally, when automobiles come back into their own the metal trades may again find themselves cramped for capacity. Already there are reports that many plants are running at their old steady rates, taking back their men, at reduced wages, it is true, but taking them back and producing. It is the general consensus of opinion that spring will see business back on its feet with a clear head. Speed the day!

CORRESPONDENCE AND DISCUSSION

Although we cordially invite criticisms and expressions of opinion in these columns, THE METAL INDUSTRY assumes no responsibility for statements made therein.

LIGHTING FIXTURES AND THE PLATING AND POLISHING INDUSTRY

To the Editor of THE METAL INDUSTRY:

The Lighting Fixture Industry is an exceedingly healthy and growing branch of electrical engineering. According to statistics recently collected by a contemporary trade publication the total yearly business in lighting fixtures amounts to over $200,000,000 —not bad progress from its exceedingly modest turnover of some twenty years ago.

Every now and then one is reminded of the comparative newness of the entire profession of electrical engineering and the vast industry which has been built upon it. Now and again we are reminded of this by some chance conversation or some letter which describes the beginnings of some of our most commonly used and essential tools. The writer believes that the two following items of lighting fixture history have never before been published. There is little doubt that one of the most essential tools in the lighting fixture business is the "cloth buff" or polishing wheel. The following interesting letter from Mr. Wm. Horn of The Horn & Brunner Manufacturing Company to Mr. C. H. Hofrichter, secretary-treasurer of the National Council of Lighting Fixture Manufacturers, tells how the cloth buff first came into being. Mr. Horn is vice-president of the National Council.

"Referring to our conversation on the subject of the origin of the Cloth Buff or Polishing Wheel as a method for polishing brass goods, the facts, as near as I can gather them, are as follows:

"My father, Mr. Herman Horn, Sr., late president of the Horn & Brennen Manufacturing Company, was born in Frankfort-on-the-Main, Germany, in the year 1836, and at the age of fourteen years, came to America, settling in New York City, where he learned the trade of grinding emery buffing with some concern, the name of which I cannot learn. Here he worked until the outbreak of the Civil War in 1861, when he enlisted with the 20th Regiment New York Volunteers, and served until its termination, being twice wounded.

"After receiving his honorable discharge, he entered the employ of the Archer & Pancoast Company, Gas Fixture Manufacturers, in the year 1867, as a Grinder and Emery Buffer, continuing with them for several years.

"Up to that time, all metal polishing was done with steel or agate burnishing tools by hand, and it was here that Mr. Horn conceived the idea that polishing could be better and more profitably done by machine and the present type of Cloth Wheel, when, through the solicitation of the Warner, Miskey & Merrill Company, of Philadelphia, he came here, and engaged with them to develop his idea.

"He first went about perfecting a cloth wheel made of numerous layers of cloth or muslin. This was done at our home. My mother would cut cloth into squares and put them together until the required thickness was obtained, after which a hole was pierced in the center, so that they would fit on the lathe spinning. His next move was to develop a cutting and polishing compound to apply to the cloth wheel, so he commissioned my brother and me to go about the various markets and butcher shops near our home and buy up what stock they had of mutton suet. This was then rendered down and poured into flat pans by my mother (who had the interest of father at heart), and after it cooled and it became hard, it was taken to the shop, where it was again melted, and a quantity of Vienna Lime worked into it, after which it was poured into flat pans, allowed to cool and then cut into cakes of the proper size for handling.

"This compound, when applied to the cloth wheel, was found to have the proper cutting qualities and produced the desired result on the metal, and ultimately facilitated the work of polishing and very materially reduced the cost to his employers, who, for a time, enjoyed a monopoly.

"However, later on, or about the year 1874, father accepted an interesting proposition from the firm of Baker & Arnold, also Gas Fixture Manufacturers, of Philadelphia, and introduced his process there, remaining with them for several years, until the death of Mr. Baker, when the firm dissolved.

"He then decided to start in business for himself, and opened a small shop at 719 Sansom street, Philadelphia, in the year 1878, and a few years later, took as a partner Mr. James Brannen, with whom he was associated until his death in November, 1917. Mr. Brannen also died a few months later, in February, 1918."

The Lighting Fixture Industry has solved many problems in the past. It has many more to solve in the future. But they will partake more and more of the nature of quantity production and reduction of overhead costs than of basic inventions. We can no longer be content to obtain results only—we must find out how to obtain them at the least possible manufacturing and selling cost. Just as the electric motor industry has evolved itself from the stage where it was somewhat of a triumph if the product ran at the right speed and kept out of the repair shops, so the lighting fixture industry must not rest satisfied with results—however beautiful and efficient—unless accompanied by reasonably low production and selling costs.

The National Council of Lighting Fixture Manufacturers is facing these issues squarely. It realizes that there are many problems which must be solved before the lighting fixture trade can take its rightful place as one of the greatest of electrical industries. One of the most urgent of these problems is that of standardization of fixture parts, and ultimately perhaps of fixtures themselves. Another is the suppression of design-piracy—up till recently the crying evil of the lighting fixture trade. The training of the mechanics of the future to meet the new conditions of manufacturing which standardization will bring is another issue which is already becoming important. Better cost-keeping systems which will eliminate reckless cutting of prices below manufacturing costs are also being urged by the National Council.

The National Council, however, realizes that to carry out all these reforms in the industry is too large a job for any organization to carry out single-handed. It can only be done through hearty co-ordination of effort on the part of every section of the industry. The National Council is therefore endeavoring to stimulate this coordination of effort in every possible way. As an example of what it is accomplishing in the direction of individual co-operation may be instanced the standardization of fixture parts already mentioned. Co-operation between different sections of the fixture industry is shown by the Buffalo Fixture Market and by the campaign now being carried on by member firms of the National Council to obtain new members for the Lighting Fixture Dealers' Society of America.

These evidences of the "get together" spirit augur well for the future of the lighting fixture business. Better business is surely coming in 1921 say the financial experts. Let each of us prepare now so that we get our fair share of orders then.

V. D. GREEN,

The National Council of Lighting Fixture Manufacturers.
8410 Lake Ave., Cleveland, Ohio, December 18, 1920.

BUFFING PROBLEM SOLVED

To the Editor of THE METAL INDUSTRY:

I am having trouble in my buffing room. One of my buffers is using up four buffs per week. His work is cutting down and roughing trimmings on brass bedsteads. The buffs are 16 in. in diameter, 7 sections thick. I pickle these trimmings before buffing, using 2 ounces sulphuric acid, to one gallon water, and washing, afterwards, in hot water. If there is any acid left on the pieces would it burn the buffs?

A. There is no reason why one buffer should use up more buffs than another providing the work is identical.

It is possible that some buffers put more pressure on their work than others. Under such conditions the buffs are worn down faster without beneficial results, than when a lighter pressure is applied.

There is no acid remaining upon the shells after you pickle them in a solution of 2 ozs. sulphuric acid per gallon of water,

and afterwards wash them in clean cold and boiling water. If there were any acid left upon the shells it would be too weak to have any action upon the buffs, unless the cloth used in the buffs is of a very poor grade. The reasons for the rapid wearing down must be as stated.

Have you ever tried using a good glazed brown wrapping paper with your buffs for cutting down? Try it. Use one section of paper to two of cloth. Years ago the writer used such a combination in his polishing department for cutting down cased brass tubing, the surface of which was as hard as steel after the brass tube was drawn over the steel tube.

Try this method and let us know the results. C. H. P.

To the Editor of THE METAL INDUSTRY:

On October 28 you were good enough to answer some queries in regard to our work asked you by the foreman of our polishing department, and you asked us to let you know the results we obtained.

We may say that using glazed brown wrapping paper between the buffs has been most satisfactory. We judge that this is due to the fact that the paper makes an air space between the buffs, and at the same time, absorbs the heat, keeping the buff cool.

Is this the way it appears to you? At any rate we have found it very satisfactory and thank you for the suggestion.

INQUIRER.

NEW BOOKS

"Straight Business in South America," by James H. Collins, published by D. Appleton & Co., New York City. Size 5¼ x 8. Price, payable in advance, $2.50. For sale by THE METAL INDUSTRY.

This book is intended to be a collection of "practical information as to exactly what business conditions are in South America, and a first-hand account of how business is conducted there, either on the spot, by the traveling man or from the home desk." It is written by a man who has been special investigator on business subjects for such publications as the Saturday Evening Post, Philadelphia Public Ledger, Printers' Ink, etc. The book comes at a most opportune time when export trade has become even more of a necessity than ever and it will do much to help American manufacturers to understand and thereby gain the confidence of their natural business associates—the South Americans. The point of view of the book is excellent. A real effort has been made to attack the problem as it should be attacked, namely, of understanding the viewpoint of both United States and South America and bringing them together. It is not an admonition to "grab the trade" and make all the money possible out of South America, but rather an explanation of the best ways to acquire their friendship and their confidence which will, of course, bring with it their trade.

"How to Keep Invention Records," by Harry A. Toulmin, Jr., with an introduction by James T. Newton, formerly U. S. Commissioner of Patents. Published by D. Appleton & Co., New York City. Size 5¼ x 8. Price, payable in advance, $2. For sale by THE METAL INDUSTRY.

The purpose of this book is to explain the necessity of keeping adequate records and the methods of doing so for inventions, both before and after they have been patented. The book states quite truly that this is one of the best methods of avoiding litigation and, when litigation is inevitable, of protecting the inventor.

GOVERNMENT PUBLICATIONS

Fourth Annual Report of the United States Council of National Defense.—A report for the fiscal year ended June 30, 1920.

Potash in 1919, by W. B. Hicks and M. R. Nourse, U. S. Geological Survey.

Sodium Compounds in 1919, by Roger C. Wells, U. S. Geological Survey.

Thorium, Zirconium and Rare-Earth Minerals in 1919.—By Waldemar T. Schaller, U. S. Geological Survey, Washington, D. C.

Magnesium in 1919.—By Ralph W. Stone, U. S. Geological Survey, Washington, D. C.

Platinum and Allied Metals in 1919.—By James M. Hill, U. S. Geological Survey, Washington, D. C.

Peat in 1919.—By K. W. Cottrell, U. S. Geological Survey, Washington, D. C.

Natural-Gas Gasoline in 1918.—By E. G. Sievers, U. S. Geological Survey, Washington, D. C.

Abrasive Materials in 1918.—By Frank J. Katz, U. S. Geological Survey, Washington, D. C.

The Tenth Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1920.—A report from Frederick G. Cottrell, Director Bureau of Mines, to J. Barton Payne, Secretary of the Interior, covering the work of the Bureau during the last year.

TECHNICAL AND SCIENTIFIC LITERATURE

THE INFLUENCE OF GASES ON HIGH-GRADE BRASS

Summary of a Paper Read at a Meeting of the Institute of Metals, Held on September 15, 1920, at the Town Hall, Barrow-in-Furness, England. By T. G. BAMFORD, M.Sc., Member (Birmingham), and W. E. BALLARD, Member (Birmingham).

1. Hydrogen dissolves in 70:30 brass in very large quantities between 500° C. and 900°C.

2. The quantity absorbed is not a mere function of temperature and pressure, but is affected by the character and dimensions of the surface.

3. The major portion of the hydrogen absorbed is usually retained on cooling.

4. Large quantities of the hydrogen retained may be removed by treatment with a neutral gas at 600° C. or above.

5. In ordinary foundry practice, using a coke-fired natural draught wind furnace, it is impossible to impair seriously the mechanical properties of the casting by overheating.

6. Cooling the metal to within 40° C. of the liquidus will certainly ruin the mechanical properties of high-grade brass which has been melted in ordinary furnace atmospheres, and will probably render the casting porous.

7. In casting tubes a higher temperature is needed than when casting solid ingots, and it is not advisable to cast 70:29:1 tubes below 1150° C.

8. Exceptionally prolonged periods of heating of the metal in the furnace do not impair the mechanical properties of the resulting casting, but of course are to be deplored for commercial reasons, on account of the consequential high zinc losses.

9. The furnace treatment is not a deciding factor in influencing the quality of the casting, but the pouring temperature is the notable factor.

10. Unsoundness is usually confined to the upper portion of a casting.

ENAMELS FOR SHEET IRON AND STEEL

Errata in Bureau of Standards Technologic Paper No. 165, on Pp. 7, 25, 28, 61, 62 and 64. Corrections can be obtained from Bureau of Standards, Washington, D. C.

SLUSHING OILS

Bureau of Standards, Washington, D. C., Technologic Paper No. 176. By PERCY H. WALKER, Chemist, and LAWRENCE L. STEELE, Associate Chemist.

A description of the general composition, properties and uses of slushing oils is given. It is pointed out that these non-drying oily materials are intended for the protection of metal parts from corrosion in cases where it is not practicable to galvanize, paint or coat with some similar permanent protective agent. Comparative tests upon many commercial rust preventive oils are given and a proposed specification has been drawn up. It is believed that satisfactory slushing oils may be purchased upon the results of simple laboratory tests given in the proposed specification.

SHOP PROBLEMS

IN THIS DEPARTMENT WE ANSWER QUESTIONS RELATING TO SHOP PRACTICE

ASSOCIATE EDITORS { JESSE L. JONES, Metallurgical
{ WILLIAM J. REARDON, Foundry
PETER W. BLAIR, Mechanical
LOUIS J. KROM, Rolling Mill
CHARLES H. PROCTOR, Plating-Chemical
CORYDEN P. KARR, Exchange-Research

ALUMINUM IN BRASS

Q.—It is probably true in all brass foundries where there are some scrap metals used, and possibly occurring with the use of commercial ingots, that a certain percentage of aluminum gets into the heat. This presence of aluminum is a serious matter with such castings that have to be subjected to either hydraulic or air test. As this evil of the presence of aluminum seems to be growing, and probably affects more or less the general brass foundry business, we are writing you to inquire if you have on file any subject matter relating to the presence of aluminum and, furthermore, if any alloy has been tried out that in a measure destroys the bad effect of the presence of aluminum.

A.—Aluminum has caused a great deal of difficulty in the manufacture of brass and bronze from scrap materials. It is possible to remove it by the addition of copper oxide in the melting bath and then puddling so as to mix the charge up completely.

However, if a large percentage of zinc is present, which is almost certain to be the case in any brass, you will find that so much zinc is lost that it does not pay. The only thing that you can do under the circumstances is to segregate all scrap containing aluminum and to use it up a little at a time, that is, by adding a small amount to every charge of clean brass.

A small amount of aluminum does no harm in the brass providing it is clean and unoxidized. If you will mix this material as stated above and take every precaution to keep from oxidizing your metal during the melting and pouring, the aluminum will not trouble you.—A. B. Problem 2,898.

BRASS MIXTURES

Q.—What is a good mixture for brass for general work of good appearance?

A.—The most commonly used brass is regular composition metal which runs about copper 85, zinc 5, tin 5, lead 5.

The mixture that has been highly recommended for appearance is copper 87, zinc 5, tin 5, lead 3.

Please write and let us know how you got along with your new work; also do not hesitate to call on us for information whenever you should find it necessary.—A. B. Problem 2,899.

BRIGHT NICKEL SOLUTION

Q.—How can I deposit nickel on cold rolled steel, bright enough to need no subsequent buffing?

A.—If the articles are small then as a rule they will be bright if plated in a mechanical solution. As brightening agent cadmium may be used, preferably in the form of anodes about the size of wet battery zincs. The cadmium anodes should be placed alongside of the nickel anodes, but only used when the nickel deposit is dull. The cadmium anodes are used in the same manner in still nickel solutions. Gum arabic is also used as a brightening agent, especially in mechanical nickel solutions. Very little is used; not more than ½ oz. dissolved in hot water should be added per 100 gallons of nickel solution at one time. Repeat at intervals of several hours until the deposit becomes bright.—C. H. P. Problem 2,900.

DIE METAL

Q.—What kind of metal is used for a die casting die, casting an alloy of 92 per cent aluminum and 8 per cent copper.

A.—The die for die-casting an alloy of 92 per cent aluminum and 8 per cent copper is made of type D Chrome Vanadium steel of approximately the following composition:

Carbon	.5
Chromium	1.0
Vanadium	.2
Manganese	.9

—A. B. Problem 2,901.

FIRE SCALING SILVER

Q.—We would appreciate any information or formulas you would furnish on mixing acids for fire scaling sterling silver work, such as cigarette and vanity cases, etc.

A.—The fire coat is usually removed from silver by mixing 1 to 2 parts nitric acid with 2 to 3 parts water. The solution should be heated as soon as the annealing has been done and while still red immerse the silver in the acid dip. The fire coat will be removed instantly. As silver nitrate is held in solution it may be recovered either as a chloride, cyanide or in the metallic form, when the strip becomes sufficiently saturated, by the usual methods of recovery.

An electro strip may be used by arranging the strip with a reversed current, the articles becoming the anodes. Carbon is used as cathodes. The solution should be warm and a good strong current used.

Formula:

Water	1 gallon
Sodium Cyanide	5 ozs.
Yellow Prussiate of Soda	4 ozs.

Use the solution hot.—C. H. P. Problem 2,902.

GOLD STRIP

Q.—How can I strip 24 karat gold from a copper slinging wire?

A.—The following formulas are used in the jewelry trade for stripping gold from article or copper slinging wires:

No. 1

Water	1 gallon
Sodium cyanide	5 ozs.
Yellow prussiate of potash or soda	4 "

Use a reverse current. The articles or wires to be stripped become the anodes and carbon or lead should be used as the cathodes. Use a fairly strong current.

No. 2

Sulphuric acid 66 deg.	1 gallon
Water	1 quart
Glycerine	1 oz.

Use carbon or lead as the cathodes, as outlined in formula No. 1. The latter strip will remove almost any metal.

It is advisable after stripping the copper wires to anneal them occasionally to restore the ductility.—C. H. P. Problem 2,903.

GOTHIC BRONZE

Q.—Will you kindly give me a formula for a finish which is termed gothic bronze. It is used extensively on chandelier work.

A.—Gothic Bronze is nothing more than a dark Japanese Bronze produced upon copper or copper plated surfaces by the use of polysulphide or liver of sulphur or similar materials as the coloring factor.

The surface should be about equal to a brush brass finish. Copper plate on this for a short time, then scratch brush the copper plated surface wet. Immerse in a solution of—Water 1 gallon, polysulphide or liver of sulphur ¼ ozs., until the color is almost blue black. Then remove quickly from the solution, wash in cold and boiling water. Dry in sawdust and scratch brush dry. Afterwards lacquer as usual. The results should be a very dark brown bronze tone or Gothic bronze.—C. H. P. Problem 2,904.

JAPANNING SAFETY PINS

Q.—The writer would be pleased to have your advice in the matter of a black finish on safety pins.

A good many years ago when connected with a factory in Connecticut they finished furniture trimmings, drawer pulls and similar articles made of sheet brass or sheet steel, brass or

copper plated, also cast brass in black, or black nickel plated. They were electro plated about fifteen minutes, rinsed in cold or hot water, and dried in sawdust. The majority of them were touched in different spots with a felt buff wheel, when the brass or copper finish would show through. After that they were cleaned and lacquered. They called this brass or copper oxidize.

Safety pins at the present time in our factory are opened and strung on frames, dipped in the japanning tank, hung on an endless chain conveyor, and put through a baking oven, which takes about fifty-five minutes for the entire operation.

Could this stringing on frames in japanning be eliminated by electroplating them in a barrel, and lacquering them afterward in a barrel with sprayer? This lacquering proposition we may overcome by experiment, but we would be pleased to get your advice on black finishing.

The writer has taken the matter up with the foreman of the plating department, and he seems to agree on getting more advice before procceding with any experiment in electro black finishing.

A.—The method you use in japanning is the only satisfactory method you can use. If it were not for the cap or shield of the pins, they could be readily japanned by the oblique tumbling barrel method, the same as used in japanning steel buttons, snap fasteners, etc., but the cap or shield possibly would not be coated by this method or might get filled up with the japan, which would be a detriment.

A solution that might be tried consists of the following proportions:

Water	1 gallon
Double Nickel Salts	10 to 12 ozs.
Sodium Sulphocyanide	3 ozs.
Zinc sulphate	1½ ozs.
Benzoic acid	1 to 3 ozs.

Voltage 2 to 3.—C. H. P. Problem 2,905.

LEAD PLATING SOLUTIONS

Q.—We would be pleased to have you give us data on lead plating. We understand there are various solutions, some costing a great deal more than others.

We thank you if you will give us about three (3) different receipts and the approximate time it would take to plate small brass castings to make a fair coating. Also the approximate price of the solution per gallon of the different receipts. Is there a special lead required for the anodes?

A.—Lead can be deposited from solutions of sodium hydroxide, fluorsilicate and fluorborate solutions.

The voltage used should approximate from one to three volts; amperage from five to fifteen per square foot of surface area.

Solution No. 1

Water	1 gallon
Sodium hydroxide, 76 per cent	1½ lbs.
Crystallized lead acetate	9 ozs.
Yellow rosin, powdered	½ oz.

Temperature, 160 deg. Fahr. Anodes of sheet lead free from arsenic should be used. This solution will deposit direct upon brass, steel, etc.

For heavy deposits, the acid type of solution is preferable.

Solution No. 2

The lead fluorsilicate solution can be purchased from the United States Metal Refining Co., East Chicago, Ind. It is a product of lead refining. The solution is used in concentrated form as received. The addition of two ounces of boracic acid per gallon of solution gives a smoother and brighter deposit. The boracic acid may be increased up to four ounces.

Uase anodes of sheet lead. Temperature, 70 deg. Fahr. at one to two volts. A small amount of glue added to the solution gives a finer grain deposit, from ⅛ to ¼ ounce will be ample.

No. 3. Fluorborate Lead Solution

Water	1 gallon
Hydrofluoric acid, 40 per cent	2 lbs.
Boracic acid	12 ozs.
Dry white lead	1 lb.
Glue	⅛ to ¼ oz.

To prepare the solution add the hydrofluoric and boracic acid to the water. Then add the white lead and finally the glue. Anodes of sheet lead free from arsenic should be used. Temperature, normal or 70 deg. Fahr.

It is advisable to copper plate steel parts before lead plating in the acid solutions or give a basic coating from an alkaline lead solution first. The following solution may be used for a basic deposit:

Water	1 gallon
Rochelle salts	3 ozs.
Caustic soda	1 oz.
Lead cyanide	2 ozs.

Temperature, 160 deg. Fahr. at 2 to 3 volts. Use sheet lead anodes. The alkaline solutions may be contained in steel tanks. The acid solution in wooden tanks, coated with asphaltum.—C. H. P. Problem 2,906.

PLATING POROUS CASTINGS

Q.—We are manufacturing quite a quantity of yellow brass castings in which we find there are small defects caused by gas.

As these parts cannot be used unless they are finished without a blemish, we, of course, lose considerable of these castings.

Writer has an idea that we could save some of these by heavily plating these with copper. We have experimented by using a solution in a five gallon quantity, containing 3 lbs. Blue Vitriol and one pint Oil of Vitriol and giving these a copper electro plate, but have not quite got the expected results. Is there anything you could suggest in this line? These castings are all finished in bright nickel.

A.—It is a very difficult proposition to fill up porous spots in brass castings by electroplating. We doubt if it can be done unless the castings were plated for a considerable time until the porous spots are actually bridged. The copper sulphate solution you have experimented with is not satisfactory. Try the following:

Water	1 gallon
Copper Sulphate	1¾ lbs.
Sulphuric Acid	3 ozs.
Powdered Alum (Use one volt.)	1 oz.

If, after plating for an hour or more at a fairly strong current, (avoiding burning however) the porous spots were not completely covered, then the only method you could use to fill up the holes would be immersing in molten tin.—C. H. P. Problem 2,907.

PLATING TEMPERED STEEL

Q.—We are sending two samples of a small hinge which we are making. One of these is in a finished state and the other one has the springs broken. We are also sending a sample of the tempered spring we use on them.

We have had some trouble with these springs breaking during the plating process, and believe it is more or less common trouble caused by the electric current on the tempered spring. We would be much obliged if you would advise us how this could be avoided, or at least somewhat modified in quantity.

A.—We presume the tempered steel springs are first cleansed in acid to remove the heat blue. If so then it is the acid that caused brittleness due to occlusion of hydrogen, which produces crystallization of the carbon steel wire.

We would suggest that the springs be freed from the heat flue by tumbling in sand and soda water. After tumbling dry out and assemble the hinge or nickel plate the springs direct after washing in water, following the tumbling operation. If you want to nickel plate the hinge entirely, then follow up by wet tumbling the entire hinge in a solution composed of

Water	1 gallon
Soda Ash	3 ozs.
Sodium Cyanide	¼ oz.

From the cleansing tumbling operation wash in water and nickel plate direct. The point to gain is to prevent the use of a strong acid in cleansing, thereby preventing hydrogen occlusion, which causes your trouble.

As a further preventative we would suggest that the nickel plated hinges be heated to 250 to 300 deg. Fahr. in an oven if possible. This temperature forces the hydrogen out of the steel and eliminates the brittleness. Try either or both methods.—C. H. P. Problem 2,908.

PATENTS

A REVIEW OF CURRENT PATENTS OF INTEREST

1,354,210. Sept. 28, 1920. **Japanning Oven.** Otto Porbeck, St. Louis, Mo.

In an oven of the class described, a housing, a corrugated wall arranged within said housing and spaced apart from one of the walls thereof, and there being a chamber formed in the lower portion of the housing and communicating with the space between the wall of the housing and said corrugated wall.

1,354,216. Sept. 28, 1920. **Process and Apparatus for Ascertaining the Hardness of Metal Parts.** Eugene Schneider, Paris, France, assignor to Schneider & Cie., Paris, France, a Limited Joint-Stock Company of France.

The process for testing the hardness of metal plates, walls, and the like which consists in subjecting the same at opposite points on opposite sides of the plate or wall to be tested to the simultaneous action of indentation means impelled by equal forces and adapted to produce indentations increasing in dimension with increase of penetration and then measuring the dimensions of the indentations to determine the degree of homogeneity of the metal at the portion tested.

1,354,234. Sept. 28, 1920. **Solder for Electroplating.** Harry M. Blaetz, Philadelphia, Pa., assignor to Royal Electrotype Company, a corporation of Pennsylvania. Filed.

A device of the class described comprising a boardlike body portion, slotted retaining guides carried by the body portion and a spring clamping member carried on the body portion and adapted to engage and clamp the plate against such body portion.

1,354,286. Sept. 28, 1920. **Method of and Apparatus for Melting and Casting Metals.** Jean Hubert Louis De Bats, Stoneham, Mass., assignor to New Process Metals Corporation, Wilmington, Del., a corporation of Delaware.

The method herein described which consists in melting and casting in a single integral structure from which air is excluded.

1,354,990. Oct. 5, 1920. **Alloy.** Foster Milliken, Lawrence. N. Y., assignor to Foster Milliken, S. Fullerton Weaver, and James M. Repplier, as trustees.

An alloy consisting of the following ingredients in approximately the following proportions, namely: iron 16 to 20 per cent., chronium 5 to 7 per cent., copper 31 to 38 per cent., nickel 38 to 46 per cent., and manganese ¼ to ¾ per cent.

1,353,472. Sept. 21, 1920. **Foundry Practice.** Arnold Haase, San Francisco, Calif.

The combination of a plurality of complete patterns; and a match board and a core print interposed between said complete patterns.

1,354,732. Oct. 5, 1920. **Casting Machine.** Ernest Disinger, Cleveland, Ohio, assignor to Willard Storage Battery Company, Cleveland, Ohio, a corporation of West Virginia.

In casting apparatus, a heating receptacle, a delivery receptacle adapted to receive metal from the heating receptacle, a traveling mold conveyor, means for shifting said conveyor so as to bring the molds successively to pouring position adjacent the delivery receptacle, and means operating in predetermined timed relationship with the conveyor shifting means for causing in sequence the delivery of a predetermined amount of metal from the heating receptacle to the delivery receptacle, and the delivery of a predetermined amount of metal from the delivery receptacle into a mold.

1,354,818. Oct. 5, 1920. **Method of Manufacturing Aluminum Chlorid.** Francis C. Frary, Oakmont, Pa., assignor to Aluminum Company of America, a corporation of Pennsylvania.

The method of manufacturing aluminum chlorid, which consists in adding chlorin and a reducing agent to a pulverulent body of aluminum dross.

1,354,824. Oct. 5, 1920. **Process of Producing Aluminum Compounds.** Heinrich Jacob Goldschmidt, Christiania, Norway, assignor to Det Norske Aktieselskab for Elektrokemisk Industri, Norsk Industri-Hypotekbank, Christiania, Norway.

The process of producing aluminum oxid from materials containing aluminum and other metals, which comprises treating the material with nitric acid, and subjecting the nitrates thus formed to such a temperature as to convert the aluminum nitrate to aluminum oxid while leaving the remaining nitrates unaffected.

1,354,848. Oct. 5, 1920. **Radius Cutter for Metals.** Adam P. Schilling and David J. Hassett, Philadelphia, Pa.

A cutting tool which comprises in combination,—a rotatable spindle extended to form a tool-carrying head,—a radial arm extending from said head and formed with a blade socket internally terminating at said tool-carrying head, externally open, formed upon one side with a bolt slot extending along its length and upon the opposite side formed with a bolt head opening similarly extending along its length,—a cutter the shank of which is formed with a longitudinal slot corresponding in placement to the bolt slot in the arm, the shank of which lies within said radial arm and the cutting blade of which extend beyond the outer opening of said arm,— and a bolt the head of which lies within the bolt head opening in the radial arm, the shank of which extends through the bolts in said arm, and which is provided with a nut external of said radial arm, whereby the shank of the cutter may be adjustably secured with relation to said radial arm, said tool-carrying head and said spindle.

1,354,874. Oct. 5, 1920. **Machine for Sawing Metals, Operating Automatically.** Frédéric Beck, Neuilly-sur-Seine, France.

A sawing machine for the simultaneous production of a number of pieces in a sawing operation, consisting of a number of saws, a carrier within which the said saws are mounted for simultaneous reciprocation in the same direction, and means for carrying the work piece, and continuously rotating it in a direction opposite to that of the effective stroke of the saws, substantially as described.

1,354,913. Oct. 5, 1920. **Molding or Like Apparatus.** James McKechnie, Barrow-in-Furness, England, assignor to Vickers Limited, Westminster, England.

A molding machine comprising a pattern plate, indexing means associated with said plate, and patterns for attachment in predetermined positions on said plate, said patterns having indicating means thereon for pointing out the correct position that any particular pattern is to occupy on said plate.

1,354,975. Oct. 5, 1920. **Pig-Metal Casting Machine.** Willis T. Hurst, Pittsburgh, Pa.

In a pig-metal casting machine, the combination with a supporting frame and a continuous mold conveyor, of a pig-receiving chute below the conveyor, a laterally movable guide supported by said frame adjacent to the discharge end of the conveyor, and adapted to direct into said chute the pigs discharged from the molds, and means for holding said guide yielding toward the conveyor.

1,354,976. Oct. 5, 1920. **Rolling Mill.** Lloyd Jones, Pittsburgh, Pa., assignor to United Engineering & Foundry Company, Pittsburgh, a corporation of Pennsylvania.

A continuous rolling mill having roll stands and having a carriage mounted for three transverse movement between two adjacent roll stands, and a pair of vertical edging rolls mounted in said carriage, together with means for positively driving said rolls in their different adjusted positions, substantially as described.

1,354,988. Oct. 5, 1920. **Alloy.** Foster Milliken, Lawrence, N. Y., assignor to Foster Milliken, S. Fullerton Weaver, and James M. Repplier, as trustees.

An alloy consisting of the following ingredients in substantially the following proportions, namely:

Copper	50 to 60	per	cent.	
Nickel	28 to 36	"	"	
Zinc	4 to 8	"	"	
Iron	4 to 8	"	"	

1,354,989. Oct. 5, 1920. **Alloy.** Foster Milliken, Lawrence, N. Y., assignor to Foster Milliken, S. Fullerton Weaver, and James M. Repplier, as trustees.

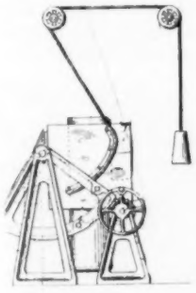
An alloy consisting of the following metals in approximately the following proportions, namely: lead 10 to 14 per cent., copper 55 to 65 per cent., nickel 6 to 11 per cent., and zinc 14 to 18 per cent.

1,356,714. October 26, 1920. **Casting Mold.** Frederick Hachmann, St. Louis, Mo., assignor, by mesne assignments, to National Metal Die Mold Company, St. Louis, Mo., a corporation of Missouri.

This invention relates to casting molds, and more particularly to metallic casting molds for casting metals. In applications Serial Numbers 159,236 and 159,237, both filed April 2, 1917, there is described a casting method and apparatus in which the mold is provided with venting passages adapted to insure withdrawal of the gases from the mold cavity, and provided with lubricant conducting passages adapted to supply to and maintain on the walls of the mold cavity, a lubricant, so as to prevent adhesion of the metal to the mold. In the molds described in the above applications, the casting to be made is a simple casting requiring no core.

One of the objects of this invention, therefore, is to provide a casting mold employing a core, in which the withdrawal of the air and other gases from the mold cavity and at the face of the core, is insured, and in which the face of the core is treated in such a manner as to prevent adhesion of the metal to the core.

1,358,620. November 9, 1920. **Tilting Furnace or Like Structure.** Walter R. Clark, Bridgeport, Conn., assignor to Bridgeport Brass Co., Bridgeport, Conn., a corporation of Connecticut.

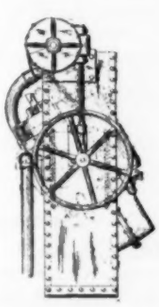


This invention relates to furnaces and like structures adapted to be tilted for the pouring off of molten metal, and it has more particular reference to a tilting furnace for melting brass or other metal and pouring the same into molds for the casting of ingots or billets.

The primary object of the invention is to provide improved means for tilting the furnace in pouring the metal into the molds so that this operation can be efficiently and expeditiously carried out without waste of metal.

1,358,621. November 9, 1920. **Tilting Furnace or Like Structure.** Walter R. Clark, Bridgeport, Conn., assignor to the Bridgeport Brass Co., Bridgeport, Conn., a corporation of Connecticut.

This invention relates to furnaces and like structures, adapted to be tilted for the pouring off of molten metal, and it has particular reference to mechanism for pivotally mounting the furnace or the like upon supporting brackets and to mechanism for counterweighting the furnace in order that the same may be easily tilted.

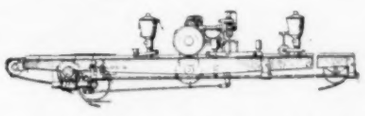


One object of this invention is to provide improved means for pivotally mounting a furnace receptacle between spaced supporting frames whereby the molten metal may be easily and efficiently poured from its receptacle into the molds.

Another object of this invention is to provide improved means for counterbalancing the weight of the furnace receptacle in order that the receptacle may be more readily tilted to pour the molten metal from the same.

1,358,480. November 9, 1920. **Solder Applying Machine.** Swan M. Tevander, Maywood, Ill., assignor to American Can Company, New York, N. Y., a corporation of New Jersey.

This invention relates in general to solder applying machines but has more particular reference to machines provided for the application of solder to the edges of the can body blanks, which are to be folded into the seam either at the side of the body or to be crimped in the flanges of the end closure.

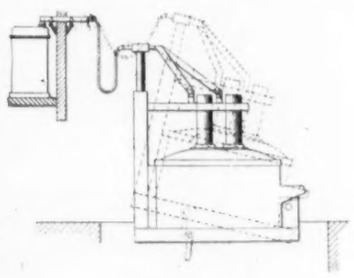


A principal object of this invention is the provision of a well organized and effective machine for the automatic applying of solder to the blank edges as they are conveyed past certain operative parts.

Another object of the invention is the provision of a machine of this character which will operate without wasting solder and without applying more solder than is desirable to the body blanks.

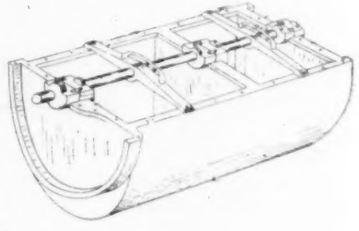
1,358,617. November 9, 1920. **Electric Furnace.** Samuel N. Castle, New Rochelle, N. Y.

The object of the invention is to improve the power factor of alternating current circuits supplying furnaces. According to the present invention, the leads carrying the heavy currents referred to, are so disposed that they are substantially free from any increase of induction by exterior magnetic material, with the result that the self-induction of the leads is very greatly decreased and the power factor improved correspondingly.



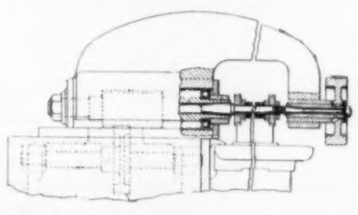
1,358,578. November 9, 1920. **Babbitting Jig for Engine-Crank-Shaft Bearings.** Robert E. Roseberry, Detroit, Mich.

The invention relates to jigs for babbitting the bearings of engine crank shafts and the invention consists in the novel construction. This improvement is designed for use in babbitting the bearings of engines for automobiles and tractors and particularly is designed for use on engines for Ford cars and Fordson tractors.



1,355,142. October 12, 1920. **Metal-Working Machine.** Bengt M. W. Hanson, Hartford, Conn.

It is an object of the present invention to prevent chattering of the tool or cutter of a metal working machine and thus entirely eliminate all the objections attendant thereto, and to this end is provided on the arbor (preferably at that side of the cutter opposite to the spindle) a flywheel which secures uniform rotation of the arbor so that the cutter thereon will run smoothly.



EQUIPMENT

NEW AND USEFUL DEVICES, MACHINERY AND SUPPLIES OF INTEREST

NEW BUFFING MACHINE

The Contour Buffing Machine Company, Inc., of 110 Bird avenue, Buffalo, N. Y., are manufacturing the surface dressing machines which are here illustrated and described. These machines are adapted to feed automatically to any standard polishing or buffing lathe, articles of oval, rectangular, triangular, or other contour, as well as articles of circular form. They are self-contained, being driven by an electric motor attached to the bed plate. The bed plate rests on slide rails which permit an adjustable travel of 8 inches to or from the polishing wheel or buff, to suit work of different diameters and different sizes of polishing wheels or buffs. The work spindle has a slow rotating motion, and is supported in a sliding frame which has a reciprocating motion of 16 inches maximum, adjustable to zero. The spindle and frame are driven by gears on a vertical shaft working in the vertical column; the column is supported on trunnions at the bed plate and is free to oscillate through about 10 degress. When the article being polished or buffed is of special contour, this oscillating movement is controlled by a cam, shown in Figure 2, adapted to the contour of the article. The guiding roller for the cam is adjustable in position by the lower handwheel and slide, shown in the illustration, and is controlled by an adjustable spring in the slide. When the article being polished or buffed is of circular form, the cam is not required, and it is substituted by a link, as shown in Figure 1.

The upper part of the column and the sliding frame is arranged to swivel by means of the worm gear and hand wheel, so that the operator may swing the article to or from the buff wheel without stopping the machine. The article being polished

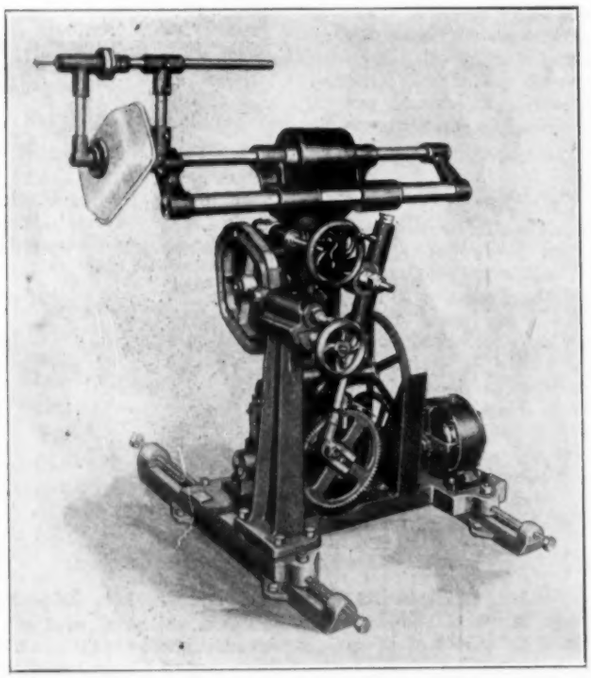


FIG. 1. CONTOUR BUFFING MACHINE USING A LINK

or buffed is held on the chuck by the work holder, as illustrated in Figure 2; the outer arm, which holds a free running washer of wood against the work, is pulled hard to the right by a long adjustable tension spring inside of the adjustable pipe at top. This outer arm is held by stops in the position shown and can be swung through a half-circle when it again engages the stops, and is held in that position while the article is being removed from the chuck and another put on.

A variable angle attachment, shown in Figure 1, can be readily attached to the outer head of the sliding frame for polishing conical articles and bottoms of pans. The gears in this attachment transmit motion from the work spindle to the short spindle journaled in the yoke bracket and extended to receive the chuck, and the yoke bracket can be swiveled through an angle of 90 degrees. When this variable angle attachment is in use, the work holder attachment is transferred to the fulcrum pin of the yoke bracket, as shown in Figure "1."

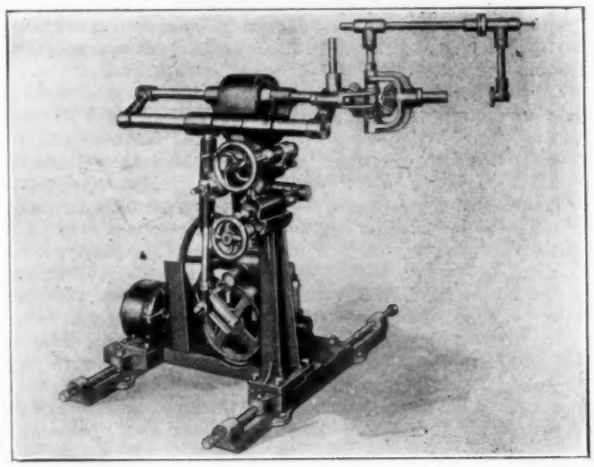


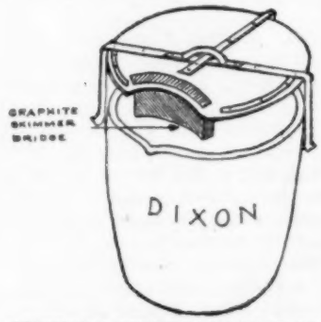
FIG. 2. CONTOUR BUFFING MACHINE USING A CAM

The motors are reversible in direction of rotation, and the article being polished or buffed is always rotated towards the polishing wheel or buff. The machines are made right hand and left hand, as two machines are run in conjunction with one polishing or buffing lathe by one man, and it is claimed that a very great saving of labor is effected.

Various modifications of these machines can be furnished to suit requirements. If the articles to be polished are all of circular form the cam mechanism can be dispensed with, and for many classes of work the mechanically operated reciprocating motion is not necessary, as the sliding frame can be moved easily by hand to any desired position and locked there.

NEW GRAPHITE SKIMMER BRIDGE

This crucible cover is made of sheet iron, with a graphite skimmer bridge, and is to be put in place after the crucible has been removed from the fire.



CRUCIBLE SHOWING BRIDGE IN PLACE

Its use will, it is claimed, do away with spelter or zinc smoke and other noxious fumes from melted metal in process of pouring.

Also, it is said to do the work of the extra man who is now required to keep back the dross when pouring is done in the old-fashioned manner. Write to Dept. 12A, Joseph Dixon Crucible Company, Jersey City, N. J., for prices.

SAND-BLAST EQUIPMENT

The Rotary Automatic Table Sand-Blast in the initial designs was limited in range of work. Its manifold advantages of continuous operation with large output, minimum labor requirements and removal of the operator from unsanitary conditions have

made this type of sand-blast a prime favorite. The wide popularity is due undoubtedly to the fact that it is now available in many variations; in fact, in no less than three systems of blasting action and five sizes being produced by one manufacturer.

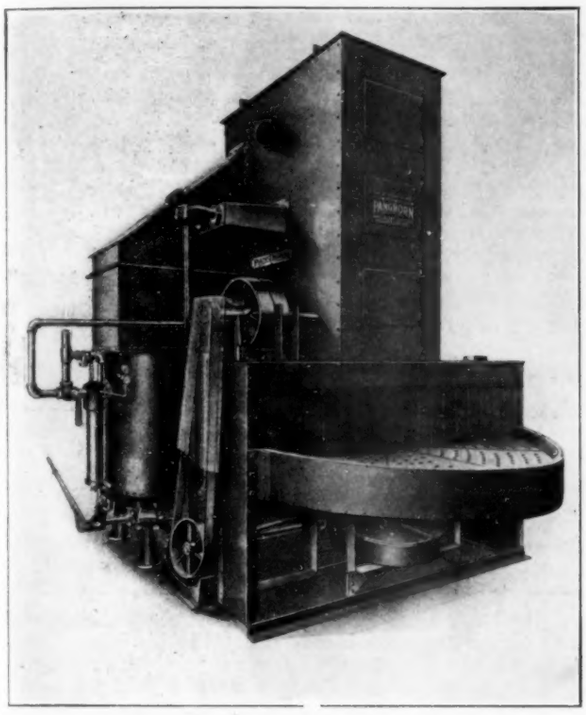


FIG. 1. DIRECT HOSE PRESSURE BLAST

For the most difficultly cleaned and larger size of work the direct pressure system is used with the blasting action supplied by a direct pressure hose blast (Figure 1) and equipped with

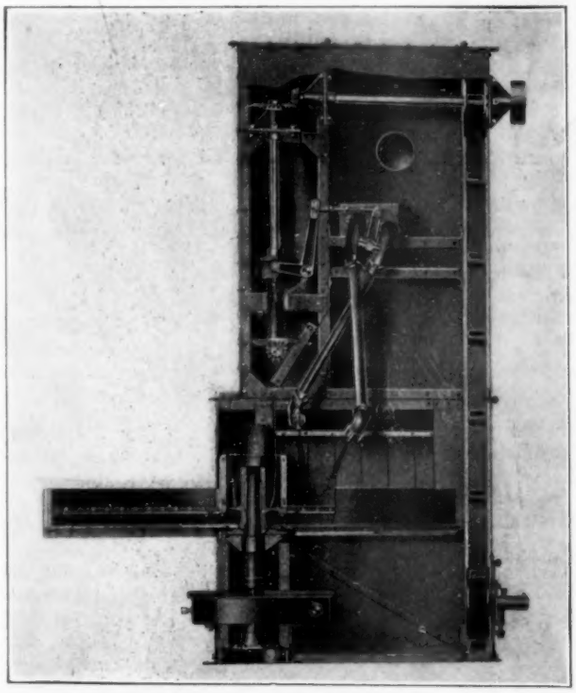


FIG. 2. SHOWING OSCILLATING NOZZLES

elevator and separator, using both mechanical and exhaust means for reclamation and separation of the abrasive for re-use. The reclaimed abrasive is accumulated in storage bins from which the hose blast is instantly refilled through a quick-acting valve that makes the operation practically continuous. This machine is made in two sizes, with table 70″ and 90″ in diameter, with clearance of 15″ between the table top and nozzles. Oscillating nozzles (Figure 2) cover the entire surface of the blasting zone, which is entirely enclosed.

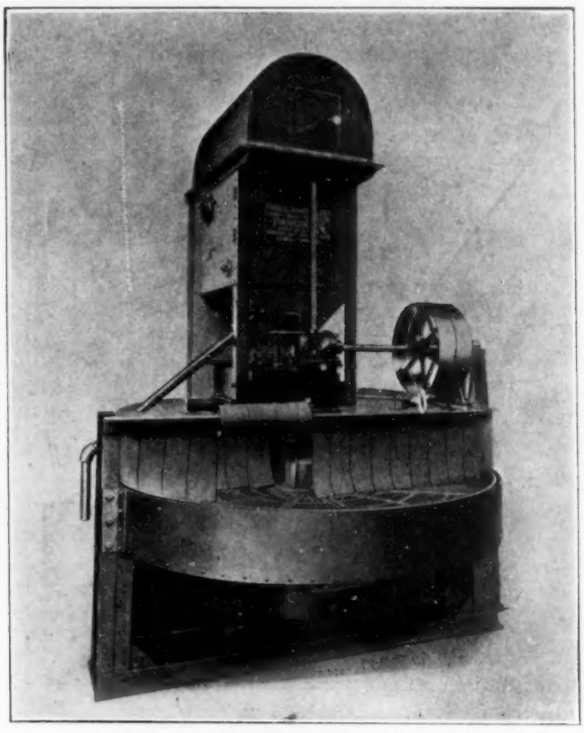


FIG. 3. GRAVITY FEED MACHINE

For work less difficult to clean, or where the intensive action of the direct pressure is unnecessary, the Gravity Feed type (Figure 3) is equally efficient and permits an entirely self-contained machine. Mechanical and exhaust action is used for reclamation and handling of the abrasive, which is fed by gravity in a continuous cycle to the nozzles, where the full force of the air is exerted for the propulsion of the abrasive. This machine, though made in but one size, with table diameter of 84″, has an adjustment of the nozzle arms that permits a clearance of 10″ or 15″ between the table top and nozzles making it applicable to the widest range of work. Like the direct pressure, the blasting action is entirely confined, and movement of the nozzles (Figure 4) covers every portion of the work within the closed zone.

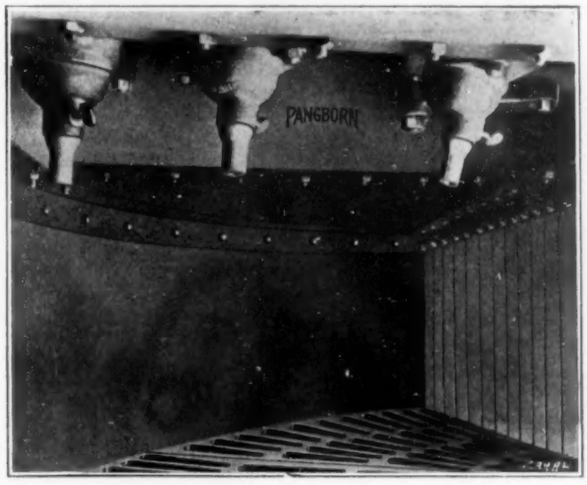


FIG. 4. SHOWING NOZZLES IN PLACE

For the cleaning of lighter work and requirements of refinishing, etc., the self-contained suction feed type (Figure 5) provides a small compact machine that adapts itself to every shop condition.

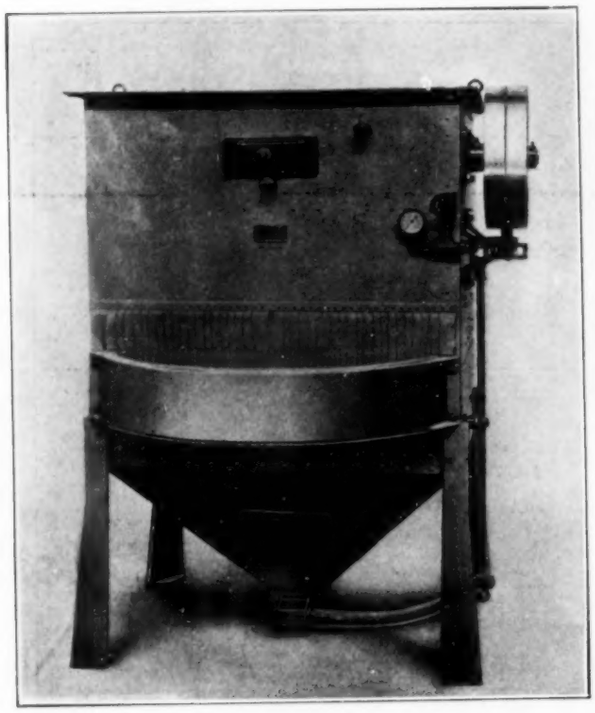


FIG. 5. SELF-CONTAINED SUCTION FEED MACHINE

The used abrasive is reclaimed through screens and the handling is without elevator use. The cleaned abrasive is carried continuously by suction or syphon to the nozzles.

This table is made in two sizes, a 42″ diameter table, with one nozzle with vertical adjustment, allowing any distance from 5″ to 12″ between the table top and the nozzles. Upwards of 50,000 Victory medals were matte finished daily on one of these tables.

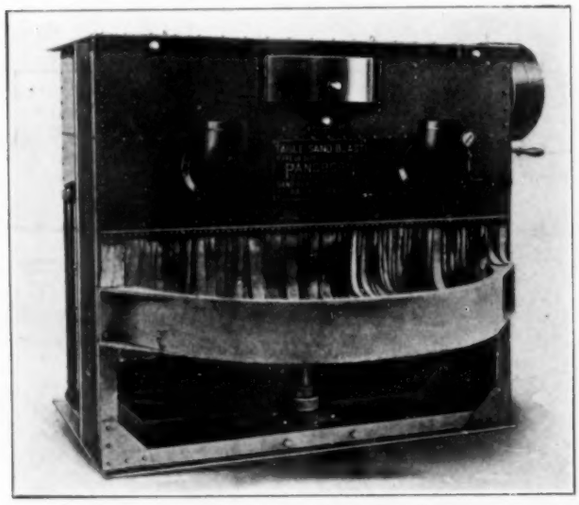


FIG. 6. MACHINE FOR LARGER WORK

The larger size (Figure 6) has a table diameter of 70″, with clearance of 12″ between the nozzles and table top, allowing for reasonably large work or a large quantity of small pieces.

Like the other models, the blasting action is entirely confined, and the nozzle movement (Figure 7) covers the full area of the blasting chamber.

The tables illustrated are produced by the Pangborn Corporation, Hagerstown, Md., and some of the models were first exhibited at the recent convention of the American Foundrymen's

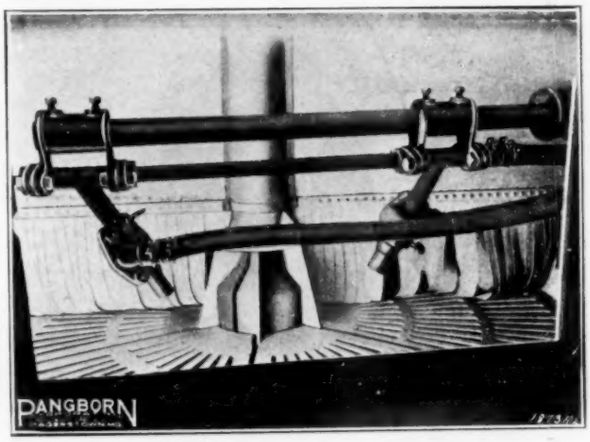


FIG. 7. SHOWING OSCILLATING NOZZLE

Association at Columbus. Literature covering the different types can be obtained from the Pangborn people.

NEW PORTABLE ELECTRIC DRILL

This portable drill is motor driven, using either alternating or direct current and automatically stops when not in use. This is due to the fact that the current contact functions through a spring lever in the handle, which is released as soon as the pressure of the operator's grip is removed, much on the same order as the valve on a pneumatic hammer or on the same principle as the "dead man" grip controller used by the elevated railway system in Chicago.

WODACK DRILL

The Wodack Drill, as it is named, is made in six sizes: 3/16, 5/16, 3/8, 1/2, 5/8, two speed, and 3/4 inches.

In addition to the drill, the Wodack Electric Tool Corporation, of Chicago, Ill., are manufacturing a portable grinder, equipped with the same novel style of control. These grinders are made in three sizes, depending on the wheel capacity, 3 x ½, 4 x 1, and 8 x 1 inches.

Both tools are fitted with Wodack Universal motors of their own manufacture. The casings are made of aluminum, and SKF ball bearings are used throughout. They have designed a motor which, it is claimed, will stand severe use and overloading; in fact, that they will rewind them once, free of charge, should they for any reason burn out within one year from date of purchase.

SLAB ZINC

Present slab zinc production in the United States is far less than normal requirements, according to accurate figures which have recently become available. Entirely disregarding the excessive demand for this metal that existed during the war, the normal monthly consumption is approximately 35,000 tons.

During the six months period which ended June 30, 1920, the slab zinc output of American producers averaged 45,000 tons monthly. For each month of the last half of this year, however, the output has been progressively reduced.

Estimates place the December production at less than 25,000 tons. This is only about 70 per cent. of the normal consumption.

An official of the American Zinc Institute said that should a substantial demand for spelter, or slab zinc, suddenly appear, the present rate of production will be far under the requirements.

ASSOCIATIONS AND SOCIETIES

REPORTS OF THE CURRENT PROCEEDINGS OF THE VARIOUS ORGANIZATIONS

INSTITUTE OF METALS DIVISION

The meeting in Columbus in October was one of the most successful that the Institute of Metals Division has held. The co-operation of the American Foundrymen's Association by having two joint sessions with them worked out very nicely. The sessions were well attended and the discussion was good.

The problem of getting interesting practical foundry papers is a great one and the co-operative arrangement with the American Foundrymen's Association has apparently helped solve it.

The winter meeting in New York is always an interesting and instructive one, bringing out a large attendance. Many of our members are glad of the opportunity to come to New York at least once a year, and this arrangement of having the winter meeting in New York City has proven very satisfactory.

All members are cordially invited to make use of the rooms at the Engineering Societies Building, 29 West 39th street, New York City, where they will find comfortable headquarters and ample facilities for correspondence and reference. It is a source of gratification that with the increased cost of everything at the present time that this combination with the American Institute of Mining & Metallurgical Engineers has enabled those men interested in non-ferrous metallurgy to reduce the cost of technical society activities and in return to receive more printed matter of interest than ever before. Everyone interested in the technical side of the non-ferrous metal and alloy industry should certainly be affiliated with the Institute of Metals Division of the American Institute of Mining & Metallurgical Engineers.

W. M. Corse, Secretary.

NEW YORK BRANCH, A. E. S.

President Sterling presided at the November meetings. A banquet committee was appointed to make preparations and conduct the 12th annual banquet to be held at the Aldine Club, 200 Fifth avenue, New York City, February 19, 1921. Committee consists of Messrs. T. B. Hoddow, N. C. Flanigan, William Voss, J. Burke, William Fischer, J. Haas. An invitation is extended to the fair sex to attend the coming banquet.

Discussions on the following subjects were held:

(1) The feasibility of the addition of platinum or gold to a silver solution to prevent tarnishing of silver deposit.

(2) The durability of Professor Madsen's nickel deposit if applied to commercial nickel plating.

President Sterling presided at the December meetings. Charles Gierdano was elected an active member of the New York branch. A letter of encouragement was sent to C. H. Buchanan, a very active and valuable member of the New York branch, whose health was reported critical. It has been decided that the dues for membership in the New York branch be advanced to $10 per year beginning June, 1921. New applicants will be obliged to comply with the above decision from date of application.

The following subjects were discussed at length at the December meetings:

1. Dip-lacquering small brass articles.
2 The composition of a grass-green gold anode.

The twelfth annual banquet will be held at the Aldine Club, 200 5th Avenue, on February 19, 1921, at 7.30 P. M. An especially attractive program has been arranged by the committee which includes the following:

1. Zinc solutions; cyanide vs. acid solutions; their composition and control; classes of work to be used on; difficulties to be encountered, how overcome and controlled.

2. Importance of anodes in plating operations. Having determined what is important, how can those conditions be obtained and maintained?

3. Current densities and voltages at which plating solutions are best operated.

4. Conditions under which pitting occurs in nickel plating.

An afternoon session, beginning at 3 P. M. will be held. Manufacturers are cordially invited to the banquet and to bring their managers, superintendents, chemists and platers. Bring your dope and make the arguments hot!

PROVIDENCE BRANCH BANQUET

Dr. Albert W. Claflin, of Providence, honorary president of Providence-Attleboro Branch of the American Electro-Platers Society, addressing the gathering at the fourth annual banquet at the Narragansett hotel, Providence, on Saturday evening, December 11, prophesied that there would be a greater advance in the art of electro-plating in the next decade than has been made in its entire history.

He urged that in order to reap the fullest benefits from this great progressive movement a closer co-operation between the manufacturers and the employes, as well as between individuals of both classes, was absolutely necessary and said that the bringing about of such co-operation would be to live up to the truest principles of the organization.

From every point of view the reception, dinner and attendant post prandial exercises which made up the programme for this fourth annual celebration by Providence Branch, was the best ever held. It attracted a gathering of more than 150 persons from Providence and the Attleboros, including a larger number of manufacturers and employers than has ever before honored the association. There were also accredited representatives from Bridgeport, Boston, New York and other branches present who extended the greetings from their respective associations.

Promptly at the appointed hour the entire party proceeded to the banquet hall where small tete-a-tete tables for four persons had been arranged, while the president's table extended along the length of the room. During the dinner and later interspersing the addresses the Temple Male Quartet rendered a musical programme, while the entire company joined in the singing of popular songs with an enthusiasm that bespoke the general enjoyment of the occasion.

President Garrick, in calling the gathering to order at the conclusion of the dinner, said in part: "It is a great pleasure for me to welcome to this annual banquet so many of our members and guests and I desire to take this opportunity to thank the members for the hearty support that they have given the officers and committees which has made this occasion so successful. Our meetings during the year that has passed since we gathered here for our previous annual have been very interesting and the year has been one of unusual progress. Our membership has increased, our knowledge has broadened and our whole sphere of influence has expanded. We are no longer an experiment. We are now a fully established, well equipped and competent organization.

"It is not my purpose to take any more of your time this evening, although there are several matters upon which I could, and would like, to address you. To me has been assigned the pleasing task of introducing, or perhaps I should say present to you, for he needs no introduction, the man who has been selected to officiate as toastmaster. I shall refer to him then as a friend, one who has been our friend and willing helper from the beginning and who is still our friend ever ready and willing to help us in every way possible, Dr. Albert W. Claflin, honorary president of Providence Branch.

In assuming the duties of toastmaster and in acknowledging the presentation by President Garrick, Dr. Claflin said: "Certainly I feel that I am among friends and that I am recognized as a friend by everyone present. Were this not so I should hardly have been honored again by your association to officiate in the position that I now occupy. I wish to congratulate you on the great progress that your association has made during its short existence and offer my sincerest wishes for a material increase during the coming year. The report made by President Garrick is a very gratifying one and while he has made reference only to the numerical increase in the association's growth, I feel assured that its progress in influence to its members and to the manufacturers cannot be measured.

"Before your association was formed each electro-plater worked for himself without any thought or care of anyone else, except to ignore him. If he learned anything new he kept it to himself and the industry gained nothing from it and no progress was made. Now, through the medium of your association the members are obtaining and increasing their knowledge of electro-plating. This is one of the principal objects for which the asso-

ciation exists and as a result of the good fellowship that has been created through the influence of the American Association, of which this is a branch, warrants me in the prediction that greater progress will be made in the next decade than has been made in the entire past history of the art.

Dr. William Blum, of the Bureau of Standards, Washington, D. C., was the first speaker, and in thanking the association for the invitation to be its guest again this year, said that he began to feel like a regular member of the association so often had he been present at its meetings. He said that it was always a pleasure to be present on these occasions, as he had always been accorded so cordial and whole-hearted welcome, which, however, he said was a characteristic of the State—small in area, but big in hospitality.

Dr. Blum took up the matter of the relations between the electro-plater and the manufacturer and pointed out what can be done by co-operation in tiding over the present period of business depression and materially assisting in bringing about a readjustment in the reconstruction period that is to follow. Both the employes and the employers must consider how they can better conditions and then work together for the successful consummation of that end. "There never was a greater opportunity," he said, "than the present to demonstrate the great efficacy of co-operation. It is necessary that everyone enter unrestrainedly into the full spirit of co-operation if they hope or expect to bring about any lasting or satisfactory results.

"Because of the unsettled and uncertain conditions the manufacturer is very apt to say that this is no time to spend money on experiments, but the employer who is so short-sighted that he cannot see the benefits and advantages that will accrue from research work that is made at this time will not be the one to profit from improvements or progress under any conditions."

Research he defined as looking for something new and after the discovery is made, being able to harness the results. He said that science, notwithstanding the great fear and trepidation that is ofttimes engendered, was nothing more nor less than systematized and catalogued knowledge, while education is the starting from the known into the realms of the unknown. He said that one of the greatest mistakes and one that is most frequently made, was the tendency to try to get too much education, which would be of immediate usefulness rather than laying the foundation that would develop with the future. He urged in correction of this tendency that greater attention be paid to the fundamentals. "Learn, not the chemistry of electro-plating," he said, "but chemistry itself, and electro-plating will beome A B C afterwards."

Past President George B. Hogaboom, of the American Electro-platers' Society, after a brief introductory salutation emphasized several of the salient points made by Dr. Blum regarding progress, science and education and said that the manufacturers often got the wrong idea of research work, its objects and purposes, and too often were afraid of it, merely through misunderstanding. This, he said, was not surprising for the reason that technical research work is beyond the conception of the ordinary manufacturer. But there is, however, much research work, he said, "that can be advantageously conducted in every factory. In doing it," he continued, it is well to approach the problem from the other end and find out what is used in processes that lead up to the one that furnishes the problem. Research," he pointed out, "means just applying common sense to the problems that come up."

Mr. Hogaboom spoke at considerable length in a technical vein on the handling of brass of different alloys and at different temperatures. He also dealt at length with similar propositions concerning gold and steel, which led to a general discussion and the conducting of an impromptu question box which proved very instructive and interesting.

Letters of regret were read from Dr. F. C. Stanley, of Bridgeport, Conn., who was on the speakers' programme, and from Charles H. Proctor, founder of the society.

The officers of the Providence-Attleboro Branch are as follows: President, John E. Garric; vice-president, Harry Shores; secretary-treasurer, Charles J. Poyton; assistant secretary-treasurer, James A. Simpson; sergeant-at-arms, Arthur W. Wood; librarian, Lewis Martin; laboratory chairman, John T. McDonough.

The committee in charge of the annual banquet consisted of the following: Gavin T. Tydall, chairman; John T. McDonough, Carlton J. Poyton, George J. Weigand and John Andrews.

GRAND RAPIDS BRANCH, A. E. S.

DECEMBER 5, 1920.

Meeting called to order by President Walter Allen in the new rooms at Vocational School, 129 Bostwick ave. Mr. Frazee gave a fine talk on what the school was founded for. The A. E. S. is also working for a new building to be erected so that Mr. Frazee can care for more pupils.

Mr. Rickson and Mr. Poe of the Grand Rapids Show Case Company presented some fine samples of nickel on aluminum and nickel and copper oxide on electric light reflectors.

BOSTON BRANCH, A. E. S.

Boston branch met December 3 at the Quincy House and had another interesting meeting. One application was received, that of Mr. Edward Joseph White, 33 Cornwall St., Jamaica Plain, Mass. It was referred to the Board of Managers. The committee on the banquet to be held at the Quincy House, Boston, Feb. 12, 1921, reported very favorably. A short discussion was held on the sulphate of zinc solution with every member present getting into it. The next subject will be the reason why zinc anodes coat over while in the solution. We had with us as our guest Mr. Philip Sievering of New York who gave a short address on the conditions at his plant and gave the branch an invitation to visit his plant at any time they might be in New York.

ST. LOUIS BRANCH, A. E. S.

This branch, having outlined a program for the season, are having their meetings well attended, and the papers presented are instructive. At the December meeting the subject was "Brass and Bronz Plating." Messrs. C. H. Howard, F. E. Terrio, and J. T. Humbrecht will present papers

The banquet committee appointed at the November meeting are busy, and arrangements are made to hold our annual affair in connection with a social and dance program at the American Annex Hotel on Saturday, January 22, 1921. This will be a real affair for the committee consists of E. J. Musick, chairman, H. J. Richards, H. Deubelbeis, G. Brandt, and C. L. Weygandt.

CHICAGO BRANCH, A. E. S.

Chicago Branch A. E. S. will hold their 9th annual banquet on January 29, 1921, at the University Club, corner of Michigan avenue and Monroe street, Chicago, Ill., at 8 p. m., and all platers, whether they are members or not, are cordially invited to attend, also the representatives of all manufacturers who may be interested in this work, as there will be a number of prominent speakers present. A number of papers will be read on topics of interest to us all. The price per plate will be $3.

BRASS MANUFACTURERS

At the annual meeting of the National Association of Brass Manufacturers in New York City, Wednesday, December 8, 1920, the following actions were taken:

It was resolved (1) that it was considered advisable for each manufacturer to guarantee prices against his own decline only, up to date of shipment.

(2) That cancellations of orders once placed and accepted, without the consent of the seller, was believed not only unfair, but a pernicious practice and economically unsound and they went on record as strongly opposing and discountenancing an uncommercial practice of this kind, and in future would not accept such cancellations.

The consensus of opinion seemed to prevail that in view of the present conditions and with the facts with which the manufacturers are confronted, that all interests would likely be best served by a reduction of approximately 10 per cent in prices.

The following are the officers for the ensuing year:

President, A. I. Fischer, Glauber Brass Manufacturing Company, Cleveland, Ohio; first vice-president, Wilson Gary; McShane Bell Foundry Company, Baltimore, Md.; second vice-president, R. B. Hills, the Haydenville Company, Haydenville, Mass.

Trustees: Messrs. R. H. Smith, Springfield, Mass.; E. F. Niedecken, Milwaukee, Wis.; Charles Lindemer, Trenton, N. J.; W. T Brace, Chicago, Ill.; Edward Blywise, Cleveland, Ohio; G. A. Harper, Burlington, Wis.

PERSONALS

ITEMS OF INDIVIDUAL INTEREST

Dr. F. G. Cottrell, Director of the United States Bureau of Mines, has resigned. He leaves the bureau to take up his duties as chairman of the Division of Chemistry and Chemical Technology of the National Research Council.

Dr. Cottrell recommends as his successor **H. Foster Bain**, of California, whose name was formally presented to the President. In his letter of resignation Dr. Cottrell said, in part:

"It is with the pleasantest recollections that I look back over my decade of service in various capacities within the bureau, and as the greater part of this time has fallen within your own administration, it gives me particular pleasure to tell you of the uniform courtesy and high standard of public service which I have always encountered in my contact with both associates and superiors throughout the whole Department.

"It would be with very deep feelings of personal regret that I should take the present step were it not that the position in the Research Council will still permit me to co-operate very closely with those particular aspects of the bureau's work for which I feel myself best fitted."

At the same time Secretary Payne handed to the President the appointment of H. Foster Bain, of California, as successor to Dr. Cottrell, by whom he was recommended.

Mr. Bain was educated and trained as a geologist and mining engineer. He was one of Herbert Hoover's assistants in London on the Belgian relief work during the war. Before that he was editor of the Mining and Scientific Press, of San Francisco Cal., and later the editor of the Mining Magazine, of London, England. He made some important mining investigations in south and central Africa and later undertook similar investigations in China. At one time he was a mine operator in Colorado and once was connected with the United States Geological Survey. Subsequently he was the first director of the Geological Survey of Illinois.

Mr. Bain was born at Seymour, Indiana. Graduating from Moore's Hill College, Indiana, in 1890, he spent two years at Johns Hopkins University and later received his doctor's degree from the University of Chicago. He has been for many years a prominent and active member of the American Institute of Mining and Metallurgical Engineers, the Mining and Metallurgical Society of America, and the American Mining Congress.

Charles Mack, foundry superintendent for the American Foundry Company, of Newark, N. J., will resign his position on January 1, 1921, and after that date will be with the Westinghouse Electric and Manufacturing Company at the Essington, Pa., plant, where he will have charge of the brass foundry department. Mr. Mack has been in foundry work for 23 years, and for the past 18 years has been in charge of the foundries with which he has been connected.

James T. Whittlesey is the director of the Pacific Coast branch which the Engineering Business Exchange, of 30 Church street, New York City, has opened, with offices in the Claus Spreckels Building, San Francisco. This will make available to the engineers and engineering industries of the Coast States the same service in bringing together the buyers and sellers of engineering and technical business properties that is being rendered by the New York office of the Exchange.

Since his removal to California eight years ago, he has been engaged in general consulting practice. He has also been confidential adviser to the Spreckels' interests, investigating and reporting on a variety of industrial and public utility enterprises.

William E. Besse, superintendent of the Coe Brass plant of the American Brass Company, expects to sail January 6 for a visit to his native country, Switzerland, to visit his brother, who is seriously ill. The duration of his stay depends largely on his brother's condition. This is Major Besse's first visit to his native country in over 35 years.

The employees of the Coe Brass plant, learning of his contemplated departure, joined last month in presenting to him a handsome fur coat as a material token of their affection and esteem. The presentation was made by Charles Cooper, assistant superintendent of the plant, and came as a complete surprise to the recipient. All the foremen and office employees joined in tendering the gift.

Major Besse has been with the Coe Brass plant for 35 years. He began in a very humble capacity, his first wage being $1.35 per day. His ability and industry soon won him recognition so that he has steadily advanced, until in 1913 he was made superintendent of the plant.

Mr. and Mrs. Fred Cheever have returned to England after spending six weeks in this country. Mr. Cheever is manager of the Torrington Company's plant at Coventry, England. This was his first visit here in five years, as he was obliged to forego his usual annual vacation trip during that period owing to the war.

Charles N. Neil, who was with the Torrington Company's plant at Coventry, England, for 23 years, has returned to this country and expects to locate in Torrington, Conn., permanently. He has been visiting his sister, Mrs. A. H. Pulver, in Torrington.

James A. Howe, who for eleven years prior to 1919 was with the Taylor Instrument Companies, has been appointed general superintendent of the Standard Works of the Keystone Watch Case Company. The plant is in Jersey City and its product is watch movements. When here Mr. Howe was a member of the superintendents' group of the Industrial Council of the Rochester Chamber of Commerce, the Rochester Engineers' Society and the American Institute of Electrical Engineers.

G. E. Brownell was appointed superintendent of the Grinding Machine Division of the Norton Company, Worcester, Mass., on November 2, 1920.

M. M. Boylston, of Sauveur and Boylston, Cambridge, Mass., has been appointed to the chair of metallurgy at the Case School of Applied Science, Cleveland, Ohio, where he will be available for consultation. The firm will continue its laboratories and offices in Cambridge under the supervision of Prof. Albert Sauveur.

Robert F. Wood, having severed his connection with the Sandusky Foundry and Machine Company, is now with the Monel Metal Products Corporation, Bayonne, N. J., as metallurgist.

Ethan Viall, on the staff of the American Machinist for ten years, has resigned as editor-in-chief to become a partner in the firm of T. W. Minton and Company, Barbourville, Ky., producers of hickory dimension stock. Before joining the staff of the American Machinist he was for three years associate editor of Machinery and before that he was for 14 years foreman and superintendent in several large specialty manufacturing plants in the Middle West. He is a member of the Society of Automotive Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. He is the author of "United States Artillery Ammunition," "United States Rifles and Machine Guns," "The Manufacture of Artillery Ammunition," "Broaches and Broaching," "Gas Torch and Thermit Welding" and "Electric Welding." The members of the staff of the American Machinist tendered him a farewell dinner December 13.

James F. Deiter, for the past 10 years connected with the Aluminum Castings Company, of Cleveland, Ohio, has severed his connections with this company as superintendent of their Fairfield plant, to accept the position of superintendent of the Scovill Manufacturing Company's new aluminum foundry at Waterbury, Conn.

T. C. Eichstaedt has made connections with the Bennett-O'Connell Company, Chicago, Ill., manufacturers of electroplating and polishing equipment, as their representative in Wisconsin, St. Paul, Minneapolis and Duluth, Minnesota, the four northern counties of Illinois and the northern peninsula of Michigan and Dubuque, Iowa.

J. L. Harman was appointed manager of the El Paso branch of The Mine and Smelter Supply Company on November 22, succeeding the late Ernest McAulay. Mr. Harman has been

connected with the company for the past three years and was promoted from the sales organization of the El Paso office to the position of manager.

Karl G. Roebling, president of the John A. Roebling's Sons Company, has returned home from a seven weeks' cruise as far as Panama and Chile. Mr. Roebling took the trip for the benefit of his health, having been devoting too much time of late to his many business interests. He is also secretary-treasurer of the Trenton Brass and Machine Company.

Mrs. Kate Nelson, the only woman electric welder in the country, has returned to Long Branch with her outfit, which is carried around in a huge truck and is complete in every particular. She is experienced in the work, having been engaged at it for the past seven years. Prior to that she was employed for a time as an engineer for the Erie Railroad Company. No job, she says, is too big for her. A short time ago she was engaged by the Consolidated Gas Company at Long Branch to look after a big job and performed it without a hitch. She has done welding jobs on railroad locomotives and has performed all sorts of difficult tasks. She always makes a specialty of guaranteeing all of her work. Although her rates are $10 an hour, she has plenty of work and is always kept busy. Mrs. Nelson has traveled all over the country and always succeeds in finding plenty of work at high rates. She says she enjoys the work and would not exchange it for any other kind of labor.

Edmund Hyde, president, the Metals Plating Company, Cleveland, Ohio, was seriously injured when his automobile was struck at a Pennsylvania Lines crossing here. Mr. Hyde suffered internal injuries.

Andrew J. Henry, president of the Standard Metal Company, Indianapolis, Ind.; was made a director just recently of the Peoples' State Bank. His election was made possible at a meeting of the board of directors and stockholders.

DEATHS

CLINTON WILLIAM ATWOOD

The many friends and acquaintances of Clinton William Whitford Atwood are mourning his death, the feeling prevailing that a valuable friend, substantial citizen and strong asset to the business world has been lost in his untimely demise. He was still in the vigor of youth and the end coming in his 35th year snuffs out a life filled with great promise.

CLINTON WILLIAM ATWOOD.

He was born October 5, 1886, at Williamsville, now the village of Goodyear. He received his early education in the public schools of Killingly, later taking a private course in textile manufacturing.

He became associated with his father, who was the head of the Williamsville Manufacturing Company, which operated the cotton mills that since have been taken over by the Goodyear Cotton Mills, Inc.

Later he became the president and treasurer of the Williamsville Buff Manufacturing Company, makers of buff wheels, being associated in the business with his brother, Harold B. Atwood. The brothers were also proprietors of the School Street Garage, located at the rear of their manufacturing plant.

Mr. Atwood was married December 11, 1911, to Miss Deborah Russell, daughter of the late Congressman Charles A. Russell.

The deceased held the friendship of a wide circle of people. He was of a genial disposition and he was always a welcome addition to any gathering. As a business man of sound judgment and strong capability, he gained a wide reputation, his straightforwardness and honesty stamping him as one whose word was as good as his bond.

Besides his wife, he leaves to mourn his loss, his mother, Mrs. Lillian B. Atwood, and his brother, Harold B. Atwood.

JOHN M. LYNCH

John M. Lynch, vice-president of the American Hardware Company, Bridgeport, Conn., died early in December, 1920.

DANIEL O'LEARY

Daniel O'Leary, of 912 West Main street, Waterbury, Conn., died Thursday morning, October 21, at his home, after an illness of only a few hours. He was apparently as well as usual Wednesday evening, but was taken ill later. The funeral was held Sunday afternoon from his home to the Church of the Blessed Sacrament, where services were conducted. He was buried in the new St. Joseph Cemetery.

Mr. O'Leary had been a resident of Waterbury for the past 30 years. He was a man who was highly esteemed by all who knew him. He had been for some years in the employ of the Scovill Manufacturing Company, and was foreman of the wire department.

JOHN STUBBS, O. B. E.

John Stubbs, O. B. E., who died, at the age of 59, on November 1, was prominently associated with the British metal trades. His father was Joshua Stubbs, of the Pitney Rolling Mills, Limited. Mr. John Stubbs was managing director of the Hughes-Stubbs Metal Company, Limited, of Birmingham, and on the amalgamation of his firm with Elliotts Metal Company, Ltd., became a director of that company. During the war he rendered great service to the government in dealing with non-ferrous scrap in the Birmingham district, in securing supplies of yellow metal and in other matters in which his experience as a metallurgist and a business man was valuable. For these services he was made a member of the Order of the British Empire.

FRANCIS E. AREND

Francis E. Arend, retired jewelry manufacturer, died at his home, 195 Deutz avenue, Deutzville, the suburban section of Trenton, N. J., December 26, 1920. He was ill about a week, death being due to pneumonia. He was in the 79th year of his age and leaves a widow and five children. Mr. Arend came to this country from Germany with his uncle, the late Adam C. Deutz, for whom Deutzville is named, about 60 years ago. Deutz erected a factory, where he began the manufacture of jewelry. The place was enlarged as business increased until it became a big plant. Later Mr. Arend took over the business, and a few years ago retired. The jewelry factory was one of the first of its kind in the east. Mr. Arend was a member of several organizations. He was an expert jewelry manufacturer, having learned the art while in Germany.

FRANK CLAYTON REX

Frank Clayton Rex, president, treasurer and general manager of the Canister Co., Phillipsburg, N. J., died recently at the Johns Hopkins Hospital, Baltimore, after a lengthy illness. He was born in Pottstown, Pa., February 14, 1872. After being educated in the public schools at that place he was graduated from the Haverford College. He took over the old Canister Company plant at Phillipsburg, and three years ago had the company reorganized. The burial was at Reading, Pa., which place he resided for many years.

TRADE NEWS

BUSINESS REPORTS OF THE METAL INDUSTRY CORRESPONDENTS

WATERBURY, CONN.

JANUARY 3, 1921.

Waterbury is doing its best to look upon the present period of depression with as much optimism as the times will bear. Some encouragement is derived from the fact that this city seems to have been perhaps more favorably dealt with than any other single section of the country.

Reports from manufacturing districts in Massachusetts and the middle west show that conditions in these places have advanced to a much more critical stage than conditions existing in Waterbury. As the depression started in the west, Connecticut was one of the last states in the country to experience its sharp inroads, and this city was perhaps the last city in the state to feel the poor business conditions.

Several reasons are responsible for this state of affairs. The wide range of products manufactured in this city bears more towards the necessities of life than to luxuries. Also the city is fortunate in having a class of far-seeing and progressive employers who have always maintained the best of relations with employees. The change in the factories of this city from a war time to a peace time basis was also accomplished with a notable lack of awkwardness. Scarcely a hitch was noticed whereas in other parts of the country the change was accomplished only after crises.

Speaking of the variety of products being manufactured in this city, a local factory head stated that business in general would need to be almost paralyzed before the city would see a general shut-down. A glance at the diversity of products manufactured in this city warrants his statement. The variety is such that the Waterbury Chamber of Commerce has long since adopted the informal catchline, "Waterbury has something on everybody"—meaning it literally. While this city would be, and undoubtedly is, affected by the depression in other parts of the country, there are still countless articles of local make which would be in demand through any depression, however great.

Waterbury, like other cities, also had its war boom. Great plants were built, and thousands of additional employees were attracted to the city. The gigantic task of transferring these huge mills to a pre-war basis was accomplished so smoothly as to be scarcely noticed. Another factor in favor of Waterbury is the fact that most of the largest plants are essentially local in character and ownership. The owners have their money, their hearts and their interest in their work. They are planning every minute in order to keep their men at work.

There is no question but that the strike of unskilled and skilled laborers of last summer has its share in the city's present comparatively favorable position. Orders were bound to pile up, and the safety margin of stock decrease. As it turned out, nothing could have been planned better. Orders were available long after the depression began to be felt in other sections, and furthermore the descending prices found the factories with a minimum of finished stock on hand.

The highest possible estimate as to the number of idle factory workers in this city gives a total of about 5,000, or 15 per cent. Allowing for those who left town during the strike, and for the release of extra hands through the ending of the war, the **Scoville Manufacturing Company** has dropped about 2,000 employes of its total of 7,000. These figures were given out by General Manager **John H. Goss.**

John A. Coe, president of the **American Brass Company,** stated recently that, roughly, about 800 hands had been dropped from the company's payroll in the Waterbury plants. At the **Waterbury Clock Company** about 50 have been laid off, according to President **W. J. Larkin.** The **Blake & Johnson Company** reports no lay-offs.

There has been practically no cut in the local wage scale. Overtime work, however, is no longer paid for on a time and a half basis, the straight hourly rate being in effect. The Waterbury Clock Company made a 10 per cent. cut in wages in November, and the Scovill Manufacturing Company is working on a five-day-a-week schedule. Aside from the 5,000 idle workers mentioned above, these are the only changes in the industrial situation to date.

Some of the idle workers are putting their time to good use, however. One of the local factories (which asks that its name be withheld), is giving away building lots in one of the most desirable sections of the city as far as good air and facilities are concerned. A number of idle factory hands have taken advantage of this offer and are erecting cottages, doing much of the work on the houses themselves. The factory has already spent upwards of $15,000 in getting the newly opened tract of land into shape. The company does not confine its gift of land to its own employes, it being available to anyone in the city. The only stipulation made in the deed of transfer is that the owner will build on the lot within 18 months of the date of transfer.

REVIEW OF YEAR

In looking back over the past industrial year in Waterbury the outstanding development is, of course, the three months' strike of the local brass workers, the first rumble of which was heard on April 6, when 100 workers walked out of the West Brass mill of the American Brass Company, after their demands for a 25 per cent. increase in wages had been refused. This was followed, on April 15, by another walkout of 1,500 unskilled workers. The strike dragged out for nearly three months, until, on July 1, John H. Goss announced officially that the strike was at an end as far as the Scovill Manufacturing Company was concerned. The last heard of the strike was on July 19, when 1,400 unskilled worbers of the New England Workers' Association voted to remain out, but it was not long before all the workers had drifted back to the shops.

The period of depression which swept so rapidly over the country following the presidential elections was first felt in Waterbury when, in the beginning of November, one of the local factories announced a 10 per cent. reduction in wages. As already stated, this has been the only reduction at any of the local factories, except the cutting to a five-day schedule by the Scovill Manufacturing Company, which of course would reflect itself in a reduced payroll. Otherwise the city, industrially, has been particularly fortunate thus far during the depression.

Prominent manufacturers who died during the year were: **John Booth Burral,** on February 8; **J. Richard Smith,** on August 2, and **Michael E. Keeley,** on October 8. No large mergers of any kind were reported.—H. G. N.

BRIDGEPORT, CONN.

JANUARY 3, 1921.

Bridgeport, where it is estimated that approximately 15,000 workers are idle, at least temporarily, is probably the hardest hit of all Connecticut cities because of the present depresssion. Because of the great war-time industries of this city the local factories suffered severely when the post-war adjustment set in and has hardly had time to recover up to the arrival of the present depression.

The latest factory affected is the **Bridgeport Brass Company.** General Manager **Guy P. Miller** announced on December 24 that on January 3, when the company's two plants were to re-open following the holiday shutdown, a general wage reduction of 10 per cent. would go into effect. Both plants closed down on December 24. Mr. Miller said that the wage reduction was made necessary by the general depression in business along industrial lines. Notices to this effect were posted in all departments of both factories.

With nearly all of the factories in the city reporting slack times, it is believed that a general city-wide reduction of 10 per cent. in wages will be announced soon. The condi-

tions have reached the stage where agents of the machinists' union have sent petitions to the factory heads asking that working hours be reduced instead of resorting to the practice of laying off men. They suggest that, for the present, 44 hours constitute a week's work. They also request that shops which have temporarily released workers, bring them back at the reduced hour schedule.

J. H. Collier, president of the **Manufacturers' Association,** thinks it unlikely that the manufacturers will adopt the 44-hour schedule. He stated that all the local factory managers are really working in the spirit of the petition of the union men, with every concern handling its own peculiar conditions. He said that it was the policy of the Bridgeport manufacturers to keep as many men employed as possible and that the petition of the union was unnecessary.

Other factories which have closed down temporarily for over the holiday weeks are the **Remington Arms-Union Metallic Cartridge Company,** which had been working but three days a week, and which closed down December 15 until after New Year's. 3,500 employees were affected. On December 16 the **Singer Sewing Machine Company** closed down until January 15. The company employs 2,000 workers. The **Bassick Company,** employing about 500 hands, also closed down about December 15 until after the first of the year.

The Singer Company had been running about 32 hours a week and President **George M. Eames** said it would be better to close down entirely at this time, as the company had about $1,000,000 worth of stock on hand.

The **Bullard Company** is running three days a week on an 8-hour basis.

In contrast to the numerous shutdowns and the period of depression which has struck the city, is the announcement by **Jenkins Brothers,** valve manufacturers, that it would distribute more than $100,000 in Christmas bonuses, on a basis of 10 per cent. of the employes' total earnings since June, when the Bridgeport branch of the concern was opened. The bonus will be paid to all on the payroll, and also to those who have been laid off because of lack of work, or because of sickness.

Bridgeport employes of the **Crane Company** also received a 10 per cent. bonus at Christmas, the total amount distributed being more than $600,000. Throughout the country, bonuses in the Crane plants will exceed $2,000,000. This is the twentieth year that the company has made a distribution of this kind to its employes.—H. G. N.

TORRINGTON, CONN.

JANUARY 3, 1921.

With the exception of the last three months of the year, business in the metal industries of Torrington was remarkably good during 1920. The factories were all working full time and the profits were satisfactory. Then, early in the fall, came the slump, and nearly all the shops cut down their working forces and began working on short time. Five-day, eight-hour schedules are now in force, with even shorter hours in some departments of some of the shops. One of the exceptions to the general rule is the **Progressive Manufacturing** plant of the **Torrington Company,** which is working ten hours a day and has enough orders on hand to keep running until well into February. The **Union Hardware Company** is also busy.

Many unskilled workers are out of jobs but the correspondent of THE METAL INDUSTRY is informed on reliable authority that practically no skilled workers are out of employment. With the coming of spring it is expected that many of the laborers will return to the farms, where workers have been in great demand for the past several years.

The manufacturers, as a whole, are highly optimistic as to the future and as soon as the minimum levels are reached in the prices of raw materials and cost of labor, it is expected that things will begin to boom again. Many had expected that the revival would begin soon after the advent of the new year, but now even the most optimistic do not anticipate much activity before April 1.

Announcement was made during the past month of the sale by **Floyd L. Vanderpoel,** of his interests in the **Trumbull-Vanderpoel Electric Manufacturing Company,** at Bantam, this county. The new owner is a syndicate composed of **Ralph K. Mason, John H. Lancaster,** of Litchfield; **Winfield Jackson** and **R. I. Healey,** of Hartford. Mr. Vanderpoel was president, general manager, and practically sole owner of the company. There was a small amount of stock in other hands, but almost all of this now has been acquired by the new syndicate, along with the Vanderpoel holdings. Mr. Mason succeeds Mr. Vanderpoel as president. **H. C. Richardson** will continue as secretary and treasurer. The company will retain the same name and will continue the manufacture of electrical appliances, giving particular attention, however, to the Mason safety switch, an invention of the president of the new syndicate. The Trumbull-Vanderpoel Company is one of the largest manufacturing concerns in the county, outside of Torrington.

The **Manufacturers' Association of Connecticut** has given out the new demurrage rates since there has been no action on the part of the interstate commerce commission against these rates. The new schedule includes the following: on cars not subject to rule, after the expiration of free time, the following charges per day or fraction of a day until the car is released: for each day of the first four days, $3; for each of the next three days, $6; and for each succeeding day, $10. The new tariff also changes the rules regarding weather interference, bunching an average agreement.

The corporate existence of the **Northfield Knife Company** was terminated on December 3.

The directors of the **Community Co-operative Company** for 1921 are: representing American Brass Company employes, Walter Harrison; Excelsior Needle, Henry Healey; Standard, E. T. Overton; Progressive Manufacturing, R. R. Richards; Hendey Machine, J. G. Lakin; Turner & Seymour Manufacturing, John Whalen; Union Hardware, Amos Jordan; Torrington Manufacturing, Eugene Bartram; general group, A. H. Wilcox.—J. H. T.

NEW BRITAIN, CONN.

JANUARY 3, 1921.

A retrospective outline of 1920 shows that the metal industries of New Britain have, during the twelve months drawing to a close, ridden on the crest of the high wave of prosperity, and now, the wave having toppled, are skidding down the smooth incline to an uncertain, but not too pessimistically forecasted future. Certainly at no time in the history of manufacturing in this city has business been any better than it has been during 1919. There is not a single factory, with the possible exception of the **New Britain Machine Company,** that has not made greater profits and done a larger business this past year than ever before. Especially true is this of concerns like **Landers, Frary & Clark,** the **Stanley Works,** the **Union Manufacturing Company,** the **North & Judd Manufacturing Company,** and others. The high tide of prosperity did not begin to recede until early in the eleventh month. Then, coincident with the depression in the financial market and the curtailment of the automobile industry and other interests, local concerns began a period of retrenchment. The North & Judd Manufacturing Company, makers of buckles and novelty hardware, was about the first to announce a reduction in the working schedule although the New Britain Machine Company, admittedly hard pressed, had previously suspended the production of its tractors, had laid off hundreds of employes and announced a general wage reduction. Next came the complete suspension of the Fafnir Bearing Company, with the announced hope that business could be resumed the first of the year, but even then it would be dependent upon the automobile industry. Then, along early in December, came a concerted announcement from the big factories, including the American Hardware Corporation branches, the Landers Frary & Clark Company, the Stanley Works and the Stanley Rule & Level Company of a week or 10 days' layoff from Christmas to New Year's. This was followed in many instances with announcement of drastic cuts in wages, averaging from 5 per cent. to 20 per cent. This was topped off with the declaration that when business was resumed, it would be on a reduced working schedule. All of which is

brought about by an unwillingness of manufacturers to make up stock on a falling market. While all this is anything but encouraging, the facts do not warrant as pessimistic an outlook as might be imagined.

With the general tendency throughout the country for lower prices, more stabilized market and a healthy revival of business, local manufacturers hope for a pick-up here. For instance, at the Landers, Frary & Clark factory, the very diversified line of products assures that concern of ample business. People must live and the necessities for domestic life that this concern puts out leaves them little to worry about. The other big concerns here are dependent upon building and its allied trades for business and to this end the manufacturers are expressing every confidence that the spring will see a nation-wide building boom. And as sure as such a boom is realized, just so soon will the local factories prosper again, for the demand for Hardware City made goods is imperative. When the automobile industry picks up, Fafnir Bearings will be in demand and as building continues and other industries pick up, so will there be a demand for Stanley Works butts and hinges and Stanley Rule & Level Company tools. Also, the demand for hot and cold rolled steel from the Stanley Works mills will increase, the demand for chucks and machine tools from the other machine shops will pick up and, as the manufacturers themselves put it, "We hope for a brisk revival of business in the spring."—H. R. J.

TRENTON, N. J.

JANUARY 3, 1921.

Many of the metal manufacturers of Trenton are not very optimistic over the outlook for the future, while some believe that by next spring business will be good again. The inevitable—the change following the war—is now taking place and the manufacturers will be glad when it is all over. They realize that high prices and high wages will not last forever and that when the final readjustment is made it will be better for both the manufacturer and the employe. Building will, of course, be a big asset to manufacturers and this is not expected to come until the prices of building material have taken a drop, but this saving has been added to the high freight rates.

William G. Wherry, president of the **Skillman Hardware Manufacturing Company,** said: "We have been doing a pretty good business at our factory and none of the employes were laid off or the working hours cut down since the war was ended. We have enough orders on hand to see us through the winter and believe that the coming spring and winter is going to be a good season."

Philip Billingham, president of the **Billingham Brass and Machine Company,** says that he believes that business conditions will become worse the fore part of the new year. Business has dropped off considerably at his plant during the past month and the outlook is not very encouraging.

It is rumored that some of the departments of the big plant of the **John A. Roebling's Sons Company** will be put on a five-day-a-week plan soon. The company refused to deny or confirm the matter.

The Baxter Plating Works have rented a portion of the Crane building on Oliver street, Newark, N. J., for a long term of years. The building covers approximately 7,500 feet.

American Stamping Company, of Elizabeth, N. J., has been incorporated at Trenton with $200,000 capital stock, to engage in mining. The incorporators are: **George M. Seaton, Elwood W. Phares** and **Clark Wittemore,** all of Elizabeth.

The **Empire Cutlery and Drop Forging Company,** of Newark, has been incorporated at Trenton with a capital stock of $50,000. The incorporators are: **George Olson, Charles H. Stewart,** of 9 Clinton street, Newark.

Morse Manufacturing Company, of Perth Amboy, N. J., has been incorporated at Trenton with $100,000 capital stock, to manufacture and deal in jewelry. The incorporators are: **Benjamin Morse, Harry Morse** and **Charles Sheer,** all of Perth Amboy.

Polmeco Cutlery, Inc., of Jersey City, has been incorporated at Trenton, with $3,000 capital stock, to deal in jewelry and cutlery. The incorporators are: **Hugo Bauer, Antonio Wapoweski,** New York; **Edward Harting,** Jersey City.

The **Jordan L. Mott Company** is feeling the slump in the business world and has been compelled to cut down on the working hours in some of the departments from nine to eight hours. The company decided on this move instead of laying off some of the employes. Other departments of the Mott Company are running on full time.

The following officers have been elected by the **Canister Company,** Phillipsburg, N. J.: President, Robert S. Childs, New York City; vice-president, Eversley Childs, New York City; secretary, Richard S. Childs, New York City; general manager and treasurer, R. W. Darnell, Phillipsburg; directors, R. S. Childs, Eversley Childs and W. Hamlin Childs. George Brewer has been made superintendent of factory and equipment. C. A. P. Bartless has been made production manager; M. H. Sheldon, purchasing agent. Mr. Darnell has been active in the affairs of the company for many years.

Universal Safety Lock Company, of Paterson, has been incorporated at Trenton with $100,000 capital, to manufacture patent locks. The incorporators are: **Antonio Caputo, R. H. Graeber** and **Matteo Tamburini,** all of Paterson.—C. A. L.

NEWARK, N. J.

JANUARY 3, 1921.

Members of the **Newark Foundrymen's Association** decided at their December meeting to co-operate with the **Employers' Association** of North Jersey as far as possible in relieving unemployment. **C. N. Wheeler,** president of the Employers' Association, which includes many foundries, called attention to the free employment bureau maintained by the employers, at 45 Academy street. If foundry owners are compelled to lay off any more men they should first consult those in charge of the employment bureau, who may be able to place the men at work.

In some plants the owners are trying out the plan of operating on part time. One, two or three days are being cut from the working week, in some places and this scheme is accepted by employers and employees as the best arrangement that can be expected under the circumstances.

During the first nine months of 1920, association members reported, their business was good. They did not have anything like the rush of orders that the years 1918 and 1919 saw, but the owners were running on full time and expressed satisfaction that the weeks of night shifts were at an end.

Most of the foundrymen asserted that they saw the fall slump coming, were prepared for it, and, consequently, are in better condition today for their policy of preparedness. The slackening of automobile making was the first blow to the foundrymen and they are waiting for a resumption of automobile trade to speed up foundry work.

December inventories also have something to do with the slack business at present, the foundrymen pointed out. Most of them look for a number of "nibbles" during the first month of the year and are hopeful that trade conditions generally will resume normal proportions before spring arrives.—H. R. K.

PROVIDENCE, R. I.

JANUARY 3, 1921.

A general curtailment in all manufacturing and industrial lines of business has marked the closing weeks of the year 1920, and, while the immediate outlook is not very promising, there is an underlying spirit of optimism that is encouraging. The tendency toward reduction of wages, the cancellation of orders and the withholding of new orders and the apparent determination of the buying public not to purchase anything but what it is absolutely obliged to, are given as the reasons for the business unrest and uncertainty that is now prevalent throughout the country.

Starting with the great textile corporations, the conditions rapidly spread to the metal and other industries until all have become affected and all are equally stagnated. It is

several years since there has been such an industrial depression throughout Rhode Island as there is at the present time. In a report just published by George H. Webb, Commissioner of Labor for Rhode Island, states that "there were 23,695 more persons unemployed in Rhode Island on November 20 this year than there were on the same date in 1919, and the indications are that the number is much greater at the present time. The figures of Col. Webb do not take into consideration the large number of persons affected by partial shutdowns, those working part time, or those who have been out of work for a week or less.

All of the largest industrial plants throughout the State are operating on a greatly curtailed working schedule. Some are closed entirely, others are working on three, four or five days a week. Most of the departments of the **Brown & Sharpe Manufacturing Company,** employing nearly 5,000 hands, are on a four-day-a-week basis, although a few departments are running on a five-day time, upon which the entire plant had been running for several weeks.

The extensive silversmithing and bronze concern, the **Gorham Manufacturing Company,** employing nearly 3,000 hands, is only running three days a week and then only giving employment to such men in the various departments as is necessary to fill orders.

The **A. B. Manufacturing Company, Inc.,** of this city, has been incorporated under the laws of Rhode Island, with a capitalization of $100,000 for the manufacture of jewelry, supplies and machinery. The incorporators are: **Nushan Asadorian** and **Charles Asadorian,** of Cranston, and **Edward C. Stiness,** of this city.

Important improvements are being made at the **Warren Foundry** on Cutler street, Warren, which include the erection of an addition to the east wing of the building. This will be used as a core room, the business at the plant having outgrown the present core room quarters. On the south side of the main building a bath and dressing room for the benefit of the help is to be installed. Since beginning business there a year ago the Warren foundry has doubled its capacity, erected new buildings and installed a new stack with double the capacity of the old. A new spark arrester is all ready to put into place and **Joseph Marshall,** manager of the plant, says he has orders ahead to keep in operation for some time to come.—W. H. M.

ROCHESTER, N. Y.

JANUARY 3, 1921.

With the year 1920 about to end and 1921 begin Rochester manufacturers employing metals are taking stock of what has been accomplished the year closing and the prospects for the new year. While the production for 1920 has not been as large as in recent years, due to a sharp let-up in orders and the unfavorable influences that always accompany a presidential election year, the grand total output will not prove to be so disappointing as was to have been expected and certainly runs far ahead of many cities throughout the country.

It is claimed that in the metal trades there have been but 1,700 workmen laid off. The Eastman Kodak Company, the biggest employer of labor in Rochester, has laid off 800 of its 13,587 employees. The Bausch & Lomb Optical Company, with a force of more than 6,500 workmen and women, has laid off about 2,000 hands. Of the 40,000 workers in Rochester not more than 5,000 are idle.

Talks with superintendents and purchasing agents of various of the bigger concerns in Rochester indicate that an optimistic feeling prevails throughout all of the Rochester industries. It is granted that the present conditions are not encouraging, and that orders have fallen off, but the larger plants anticipate that before spring flowers smile industrial Rochester will hum again. In fact, it is said that the Eastman Company officials estimate but a 15 per cent reduction in total output for 1921, and believe that it is possible this estimate may be wiped out. At Bausch & Lomb's big plant, the General Railway Signal Company. The Pfaulder plant, the can companies and the various machine and tool plants a more hopeful condition actually prevails. It is expected that wage adjustments will be made long before spring, which will tend to settle matters all around.

Shipping conditions are much better in Rochester, both by rail and express, the only drawback now in sight being the poor postal service given the city. This city is a plague spot in that respect and has been for five or six years.

Frank N. Brayer, president of the **Co-operative Foundry Company,** in behalf of the company, gave each of the employees a life insurance policy for $500 as a Christmas gift. The policies increase $100 annually until the total amount reaches $1,000.

The Bausch & Lomb Optical Company shut down completely for inventory during the holiday week. It will resume on January 3. The company now employs 4,000 persons, compared with 2,600 before the war. The volume of the company's business is normal and some of the departments have many orders to be filled. During the war more than 5,500 persons were employed there, and reductions in the working force now have been made in the trend toward normal conditions. No further reductions in the force is contemplated. The company shuts down twice each year for inventory, making two weeks altogether. G. B. E.

ROME, N. Y.

JANUARY 3, 1921.

The close of the year found activities in the metal plants in this city almost at a standstill. Taking of inventories in most of the factories in a measure accounted for the existing curtailment of operations, but no doubt lack of orders, due to a recession of prices on basic metals, also had something to do with the temporary shutting down of the shops.

Business held up very well here during almost the entire year and when the inventory period is over it is predicted that practically all of the brass and copper plants of this city will resume operations, at least in a moderate degree, and a steady increase in working operations is look for until the full capacity point is again reached.

Beyond forecasting a prosperous period which will soon begin its onward march to old-time stability and contentment both for employer and worker, those who keep in touch with metal industry affairs in this locality make no further comment. They are confident of the future and believe the recent slump in the brass and copper business was to be expected and a natural step on the road to readjustment and sound business conditions. Therefore, the transition period which business is undergoing at the present is to be welcomed rather than postponed. M. J. D.

INDIANAPOLIS, IND.

JANUARY 3, 1921.

A statement refuting the declaration in several newspapers outside of Indianapolis that 20,000 persons are out of employment in this city has been issued by the Indianapolis branch of the National Metal Trades Association. They stated that because of the fact that Indianapolis is a city of greatly diversified business and industries, which absorbed the relatively small number of workers that has been laid off in the automobile and kindred metal trade lines most affected by economic readjustment, that there is little, if any, real unemployment in that city. The following comparative figures were given in the statement as to the number of persons employed by the fifty-three Indianapolis manufacturers of automobiles, accessories and other products: Nov. 1, 1919, 15,844; May 1, 1920, 21,200; July 1, 1920, 21,869; Nov. 1, 1920, 12,622. The following report was made from nineteen large metal trade manufacturers; Nov. 1, 1919, 11,025; March 1, 1920, 11,738; July 1, 1920, 11,695; Nov. 1, 1920, 8,449.

Announcement has been made here that the **Shelbyville Foundry Company,** at Shelbyville, Ind., has completed its plant and started operations. Officials of the foundry say thus far they have been able to secure a good repair business and until this falls off they will not make a very serious attempt to secure new business.

Plans have been completed and most of the contracts awarded for the construction of an immense foundry and machine shop for **Weil Brothers,** of Chicago, at Michigan City, Ind. The plans were drawn by engineers of the company and provide for one-story buildings of brick construction, reinforced by steel, to cover 100,000 square feet floor space. W. R. Stockwell is general manager of the company.

The Terre Haute plant of the **Grasselli Chemical Company** was given a lot of publicity in the official publication of the Terre Haute Chamber of Commerce recently. The Terre Haute branch has grown rapidly since its beginning there some years ago. This particular plant receives zinc ore after it has been treated chemically where the sulphur content is converted into sulphuric acid. The plant consumes about 250 tons of coal a day, employs 325 men and has a monthly pay-roll of more than $35,000 when in full operation.

The **La Velle Foundry Company,** of Indianapolis, located at Michigan and Miley streets, recently took out a building permit for the construction of a new foundry building which will cost approximately $52,000. The plant will be built on a site now owned by the company adjacent to its present plant. E. B.

CLEVELAND, OHIO

JANUARY 3, 1921.

Leading financiers of the Northern Ohio district point out that while 1920 has developed surprising features in connection with the progress of business forward on a stable basis, each development has been logical. Though a substantial liquidation has taken place, less damage has been done than otherwise might have been had not big business people foreseen what was coming. Moreover, it is claimed by these interests that history is but repeating itself—that the same conditions have occurred under like circumstances.

Because Cleveland industry was the first to feel the better business effects of the war, it is but natural that industry here should feel that it suffers most, these financial interests point out. This is a wrong attitude, they assert, pointing to the fact that conditions in general are world-wide in their scope and effect upon business. It is emphasized that while commercial mortality may be large everywhere, business failures in the United States during 1920 have been fewer than in normal years preceding the war. This is considered one of the most important features looking to early stability of all business, it is claimed by financiers.

Meanwhile the new year starts off, as far as the metal industry is concerned, with no improvement in sight for the automobile, truck, hardware and other kindred lines closely related to the metal industry. Truck interests here are operating at approximately 15 per cent. of capacity. Retail buying of regulation motor cars has not improved. Hardware production is curtailed, as there seems to be plenty of merchandise to meet all current demands. For the same reason the machinery and machine tool business show no signs of revival immediately.

All of these conditions are traced to the reduced buying power, which, while apparently as great, does not show in actual orders though it must be admitted that inquiries, concerning deliveries after the first of the year have been more frequent in all directions in the last few weeks.

Most optimistic feature for the metal industry here is the prospect for early revival in the building industry. It is conservatively estimated that $104,000,000 building is pending. While a good deal of this is public work, notably schools, and which will be backed by liberal bond issues voted for at the polls by electors last November, there is a considerable amount of private work, many large office and commercial structures and the like, and none of this work includes numerous apartment house, small hotels and similar construction.

Among the earlier projects to become effective early in the new year will be the factory addition to the **Brook Manufacturing Company,** Brook Park road, which proposes to erect a 60 x 150-foot addition to its original plant at a cost of $50,000.

The **National Bronze and Aluminum Foundry Company** is preparing for increased demands for its output by the recent purchase of factory building and land in the southeastern manufacturing section of town, where it will have an additional 46,000 square feet of operating space. The company specialized in aluminum and bronze castings for automobile and machine tool uses.—C. C. C.

DETROIT, MICH.

JANUARY 3, 1921.

The year just drawing to a close has been one of the most trying, from an industrial standpoint, that Detroit and the state in general has ever experienced. With the exception of the first two or three months, the entire year has been one of general decline and uncertainity, and even at the present time there is nothing definite on which to base a forecast that is in any way reliable. One man's guess is just as good as another, although somewhat more faith may be placed on forecasts made from comparisons with former lean years. There is every reason to believe that the automobile industry, at present at almost a dead standstill, will begin to show a substantial revival some time along in February, directly after the mid-winter shows. This always has been the rule in former years of depression, and it will quite probably be the case this time. Most of the automobile companies are doing but little. The **Ford Motor Company** seems to be the busiest of all, but it is working its forces only five days a week—that is, it still is employing about 50,000, running 24 hours throughout the week, but each man works only five days at a stretch. In this way the Ford company is maintaining its great organization in a high state of efficiency and will be prepared to begin intensive production just as soon as the occasion demands. As they are working at present most of the other companies will be more or less handicapped when the time comes again to start heavy production.

One good feature of the whole situation is the general optimism that seems to pervade the entire business world, at least here in Detroit and the surrounding territory. No one seems to be very much discouraged and almost everyone is talking of the good times that are to come and are honestly preparing for them. Thus far no great failures have been reported in any line and those concerns that have gone under are outside of the metal industry.

There is little demand for labor just at present and a great many men are out of work. However, little hardship is reported, as labor in general seems to have prepared itself in Detroit for just such an emergency as it is passing through now. This cannot last long, however, and if the plants fail to resume in a reasonable length of time Detroit labor very likely will experience much hardship.—F. J. H.

LOUISVILLE, KY.

JANUARY 3, 1921.

Reviewing conditions in the metal working trades of this district for the past year it is found that most of the companies did a rattling good business up through November, several showing increases for the first eleven months, but going backward in December. The general slump in buying struck hard during late November, and by December there was not much demand for anything that was not absolutely needed for immediate use.

Prospects for the coming year are a bit cloudy just now, as it is a question as to whether buying will revive to any extent during the first three months. It is claimed by some of the local operators that prices can't decline enough to revive business until labor is willing to accept cuts, and get on a more normal basis; that today labor wants prices of all foods, clothing, rentals, amusements, etc., at pre-war figures, but wants war wages, and that such conditions can't prevail much longer.

It is claimed by some of the copper and brass working concerns that while they did a fairly good volume of business in 1920 there was no large profit in it, due to the high cost of labor, increases being given labor twice since July, while another increase goes into effect on February 1, 1921, under an agreement reached following a strike in the early fall.

E. E. Sherman, of the **Vendome Copper & Brass Works,** in discussing conditions said: "We had a fair year as a whole, and with the new departments for casting work, and for aluminum as well as sheet metal work, we are in better position to catch a fair volume of business during the coming year than ever. However, it looks to me as though things are going to be a little slow for some time to some.

Matt Corcoran, Jr., of **Matt Corcoran & Company,** in discussing the situation said: "It is rather doubtful now, and I can't see where there will be any heavy volume, but I guess we will have enough business coming in to keep us fairly busy, as it generally develops when it is least expected.

J. W. Rademaker, of the **Independent Brass Works** stated that the concern was operating with four men as against ten men a few weeks ago, but had shown an increase for every month of the year except December.

The vice-president of the **Louisville & Nashville Railroad,** at a recent meeting of the Louisville Board of Trade, reported that the road would spend $33,000,000 in improvements, including cars, engines, roadbeds, etc., and already its shops are humming, and a lot of work has been placed with the American Car & Foundry Company and other shops.

Information received by the jewelry trade of this section is to the effect that there will be a seven or ten per cent reduction if not more in prices of general lines of silverware in the new year, as a result of the big slump in silver bullion, and the sharper decline in Canadian silver.—Q. V. N. S.

MONTREAL, CANADA

JANUARY 3, 1921.

There has been complete unanimity of opinion among prominent industrial leaders and financiers in this metropolis of Canada with respect to the probable course of events in the manufacturing and business world. They agree that a few months hence business improvement will be in full swing. The interim is expected to be difficult and to bring troubles to firms that lack resources. From the stock market point of view the opinion is held that for the greater part the extended decline in security prices has discounted the worst of the industrial situation.

For the closing week of the year the metal market prices are at their lowest ebb registered and we are apparently in for an irregular market, with periods of ups and downs, before the permanent advance sets it.

The establishment of **Rubenstein Brothers,** 41 Craig street, gold and silver electro platers, was broken into on the morning of the 24th by burglars and all the money and bullion which was contained in the safe, amounting to about $6,000, was taken.

The different brass manufacturing concerns have curtailed their hours of employment and kept their full forces of employes and organizations intact. Robt. Mitchell Company, Ltd., the oldest brass manufacturing concern in Canada, are running their foundry and finishing shops to their full capacity on their regular lines of goods, and orders for brass car trimmings to be furnished to the **Canada Car Company,** also the **Dominion Car Company,** who have domestic and foreign orders to keep them busy for four months.—P. W. B.

BIRMINGHAM, ENGLAND

DECEMBER 20, 1920.

Manufacturing depression is steadily increasing. The situation is reflected in the steady decline in metal prices. Standard copper in the London market has fallen £13 in the last four weeks and tin and lead have shown still greater declines. Spelter has reached a price far below that at which it can be produced in this country and five firms have had to shut down their spelter plant. Business in the galvanizing trades has fallen off considerable. Corrugated sheets are quoted at less than two-thirds of the spring prices, while price control in the galvanized hollow-ware trade has entirely broken down and manufacturers are rushing to unload stocks accumulated in the expectation of continued good demand. Two or three large sheet mills have been closed and others will have to follow suit shortly if things should not improve.

The brass trade, which was among the last to feel the slump in business, is now short of work in many departments. As in other trades, cancellation of orders has become a common experience. There are potentialities of good business in water and steam fittings, especially in Australasia, but the prohibition of the export of gold and the absence of facilities for goods exports from Australia are causing the holding up of consignments from this country. The rolling mills up to the present have been working at full pressure, but arrears are now nearly cleared off and new work is coming forward very slowly.

Electro-platers have again become very busy. Large orders are being executed for hotels, clubs, restaurants, ship-reconditioning both at home and abroad. The spoon and fork business is particularly good. The jewelry trade, though the approach of Christmas has given a little stimulus to business, is still working a good deal of short time, whereas at the beginning of the year overtime was being worked to cope with the requirements of the home trade alone and foreign orders were being refused. German competition is beginning to be felt, while in the gold and silver chain departments there are complaints of increasing dumping from America of machine-made chain. The comparative cheapness of gold in the United States favors the American manufacturer as against the British in this and other departments of the jewelry trade. Makers of the more costly silverware in Birmingham and Sheffield find business falling off considerably. Orders are not being renewed and short time in the silversmiths' trade is becoming more and more general. H. & G.

VERIFIED NEWS OF THE METAL INDUSTRY GATHERED FROM SCATTERED SOURCES

The estate of **James McLean,** vice-president of Phelps Dodge & Company, the large copper producers, who died January 7, 1920, was appraised at $11,741,799. Of this, 18,500 shares in Phelps Dodge & Co. accounted for $4,391,715.

The **McDonald-Churchill Corporation,** 103 Park avenue, New York, has worked out a new method for increasing profits by increased turnovers as against increased capital.

The **Goulds Manufacturing Company,** of Seneca Falls, N. Y., manufacturers of Goulds pumps, announces the appointment of **Edward S. Jenison** as acting general sales manager to succeed **W. E. Dickey,** who retired from business on January 1. For the past five years Mr. Jenison has been manager of their Philadelphia office.

The U. S. Plating Works, 1182 South San Pedro street, Los Angeles, Calif., has been organized to plate trunk hardware. They are also doing general job plating, specializing in automobile work. They expect to manufacture an automobile accessory in the near future. V. I. Powells and E. A. Snelson head the company. Their departments are plating, polishing and lacquering.

Fire destroyed a part of the **Utica Valve and Fitting Company's** plant at Utica, N. Y., with a loss of about $50,000. They manufacture gas fixture fitting valves, etc., and operate a brass, bronze and aluminum foundry, brass machine shop, tool room, grinding room, polishing and lacquering departments.

The American Metal Products Company, 671 Kinnickinnic avenue, Milwaukee, Wis., has postponed until next spring the building of a foundry and machine shop at West Allis. The plant will consist of a brass and gray iron foundry 50 x 75 feet and a machine shop, 75 x 150 feet. The company manufactures brass, bronze and aluminum castings, operating foundry, grinding room and casting shop.

The American Stamping Company, Elizabeth, N. J., has been incorporated by Elwood W. Phares, H. A. Hills and G. M. Seaton, 309 Pine St., to manufacture stamped metal goods, plating materials, etc. Capital $200,000. They operate stamping, japanning, lacquering departments.

The Quebec Brass Foundry, Des Prairies and Valier streets, Quebec, has contracted for the erection of a brass foundry to cost $13,000, operation of which will begin next month. They operate a brass, bronze and aluminum foundry.

The Wales Adding Machine Company, Wilkes-Barre, Pa., has increased its capital from $1,000,000 to $3,000,000. They operate a tool room, grinding room, spinning, stamping, plating, polishing and japanning departments.

The proposed merger of the **American Foundry Equipment Company,** 366 Madison avenue, New York, and the Whiting

Foundry Equipment Company, Chicago, Ill., has been abandoned.

A. P. Munning and Company, Matawan, N. J., have opened an office at 601 First National Bank Building, Cincinnati, Ohio. The office has been placed in charge of F. G. Cyrex.

At a recent meeting of the stockholders of the **E. A. Bliss Company,** Meriden, Conn., manufacturers of table silverware, it was voted that the name of the corporation be changed to The Napier Bliss Company. The officers of the company will be the same as heretofore. James H. Napier, president; William E. Bliss, vice-president; Harry M. Smith, secretary and treasurer; Edward A. Schwartz, sales manager.

James H. Rhodes and Company, 115 Fulton street, New York City, manufacturers of abrasives, polishing materials, etc., have awarded a contract to the Guarantee Construction Company, 140 Cedar street, for a plant in the Degnon Terminal District, Long Island City, consisting of three buildings, five stories, four stories and one story, 40 x 40 ft., 40 x 40 ft., and 80 x 200 ft., respectively, and estimated to cost about $200,000.

The Frontier Brass Foundry, Inc., Niagara Falls, N. Y., has filed a notice of reorganization with an active capital of $41,250, and preferred stock to the value of $40,000, with 250 shares of common stock of no par value.

The Tuxis Metal Company was incorporated recently for $50,000. The officers of the company are: A. J. White, president; A. E. Gowrie, vice-president; M. Y. Lifsher, treasurer; P. M. White, secretary. The company deals in scrap iron and metals, and also in new and second-hand machinery.

The Manufacturers' Electro Plating Material Company, 1647 St. Clair avenue, N. E., Cleveland, has changed its name to the Industrial Supply Company. The personnel of the company remains the same.

The **Unbreakable Mirror Company,** Hackettstown, N. J., announces that its property is for sale due to the filing of a lien against it by the United States Internal Revenue Department for taxes for 1917 and penalties, which have not yet been paid. The money for these taxes was used in the purchase of new equipment for increased business. The next year was poor and since the Government insists that the taxes be paid at this time, with other obligations falling due, the company is forced to sell its property.

National Anode Company, Delawanna, N. J., announces that **A. R. Bray, C. S. Wells, L. M. Wells** and **M. L. Wells** are no longer connected with them.

The American Brass Products Company, South Madison street, Pottstown, Pa., has increased its capital from $150,000 to $250,000, which will widen the business facilities of the concern. No plant enlargement is on the program at this time. H. M. Merrick, of Pottstown, is the president, and C. E. Pyle, of Philadelphia, the secretary and treasurer. This company operates a brass machine shop, tool room, grinding room, brass forging department, and stamping, soldering, plating and polishing departments.

The **E. J. Woodison Company** has changed its Detroit address to 7415 St. Aubin, Detroit, Mich.

A site for the new building in Washington which is to serve as a home for the **National Academy of Sciences** and the **National Research Council,** has recently been obtained. It comprises the entire block bounded by B and C streets and Twenty-first and Twenty-second streets, Northwest, and faces the Lincoln Memorial in Potomac Park.

BRITISH METAL FIRMS MERGE

The latest amalgamation is that of Muntz Metal Company, Limited, with Elliotts Metal Company, Limited. This recalls a long and interesting chapter in the history of the metal trades. The Muntz family originally belonged to the landed aristocracy of Poland. Driven first from their own country and afterwards, by the Revolution, from France, they settled in Holland. Peter Frederick Muntz, trading as a merchant, came from Amsterdam to Birmingham at the beginning of the 19th century. Shortly before his death, which occurred in 1809, he had purchased a brass mill. His son, George Frederick Muntz, who at the age of 16 took over the control of the mill, concluded that to make the business a success it was necessary to find a brass that could be rolled hot. The researches he set on foot resulted in the production of Muntz Metal. The patent taken out in 1832 was upset, but the trial, by the publicity given to the merits of the metal and the metallurgical skill of the producers, proved a blessing in disguise. In sheathing metal for ships and in other non-ferrous materials a business was built up which restored the former prosperity of the family. The Muntzs became large landowners in the district, and members of the family have represented Birmingham and neighboring constituencies in Parliament. Though they had acquired the status of country gentlemen, there were always some of them associated with the Birmingham business, the present head of which is Sir Gerard Muntz, baronet, a past president of the Institute of Metals. The works are at Smethwick on the outskirts of Birmingham.

The members of the firm of Elliotts, Limited, was one of the early rivals of the Muntz firm in the metal trade. The company has works at Selly Oak, a district recently included in the city. It has carried on extensively a similar business to that of the Muntz firm, and has from time to time absorbed other metal rolling and tube concerns Muntz Metal Company, which was incorporated in 1863 and reconstructed in 1890, has a subscribed capital of £251,661 and for the last five years has paid a dividend on the ordinary shares of 10 per cent. Elliotts Metal Company was formed in 1874, and in January, 1918, acquired the business of William Cooper & Goode, Ltd., and the Hughes-Stubbs Metal Company, Ltd. Its paid-up capital amounts to £417,423, in addition to £156,479, representing debentures still outstanding. Its dividend on the ordinary shares during the past six years has been 15 per cent.

TRADE PUBLICATIONS

Calendar.—An attractively illustrated and well designed calendar for 1921 has been issued by the Crown Rheostat and Supply Company, Chicago, Ill.

Small Turbo-Generator Sets.—Bulletin No. 42110A, issued by the General Electric Company, illustrating the small Curtis Steam Turbine Generating Sets.

Marcy Mill, a Crusher with Capacity.—Catalog No. 62, issued by the Mine & Smelter Supply Company, New York, illustrating, and describing various installations of the Marcy roller mill.

Get the Most From Your Patterns.—A folder issued by the American Foundry Equipment Company, New York City, showing how American composition patterns mounts are applicable.

Tax Payment Days.—A calendar issued by the Guaranty Trust Company, New York, giving the due days for returns and payments of Federal, New York State and New York City taxes for 1921.

Heat Treatment Furnace.—Car type and car-and-ball type—Bulletin 222, issued by the W. S. Rockwell Company, New York, showing various furnaces of the above mentioned type for use in heat treatment methods.

Marcy Roller Mill.—A catalog issued by the Mine & Smelter Supply Company, New York, illustrating the new type of Marcy mill. This mill is run with long roller bars as the crushing medium instead of the usual balls.

That, That Is, Is.—A booklet issued by Frederic B. Stevens, Detroit, Mich., which very entertainingly mixes business with pleasure. It includes a number of stories and a description of a large number of Stevens' products.

Thermit Carbon-Free Metals.—Pamphlet No. 20, Fourth Edition, issued by the Metal & Thermit Corporation, 120 Broadway, New York. This pamphlet gives a complete list and description of the Thermit carbon-free metals and alloys.

Reliance Buffing and Polishing Compositions.—Bulletin No. 12, issued by Chas. F. L'Hommedieu & Sons Company, Chicago, Ill., which describes and illustrates the different grades and kinds of compositions manufactured under the trade mark "Reliance."

Stationary Engines, Marine Engines and Oil Engine Generating Units.—A catalog issued by the Dodge Sales & Engineering Company, Mishawaka, Ind., describing the Dodge engines of these types. The catalog is printed on excellent paper and contains 15 illustrations.

METAL STOCK MARKET QUOTATIONS

	Par	Bid	Asked		Par	Bid	Asked
Aluminum Company of America	$100	$580	$630	International Silver, com.	100	24	40
American Brass	100	152	163	International Silver, pfd.	100	84	88
American Hardware Corp.	100	130	134	New Jersey Zinc.	100	128	132
Bristol Brass	25	...	19	Rome Brass & Copper	100	135	145
International Nickel, com.	25	15⅝	15⅞	Scovill Mfg. Co.	100	340	350
International Nickel, pfd.	100	75	78	Yale & Towne Mfg. Co.	...	255	270

Corrected by J. K. Rice, Jr., & Co., 26 Wall Street, New York.

METAL MARKET REVIEW OF 1920—OUTLOOK FOR 1921

WRITTEN FOR THE METAL INDUSTRY BY W. T. PARTRIDGE

Progress made in the necessary readjustment of general business affairs during 1920 to meet the changed economic conditions existing all over the world following the Great War, was accompanied by many painful experiences in various directions. In some cases, apparently disastrous effects were produced, menacing the very foundations of established customs and conditions, but the year closed without either the financial collapse of nations or of civilization, as had been predicted by the pessimistically inclined, who could see no relief ahead.

Among the many problems to be solved were the critical foreign exchange situation, export and credit conditions, deflation of commodity prices, the attitude of union labor and the reduction of wages, made necessary by the lessened volume of business which in many instances during the latter half of 1920, practically paralyzed industry and trade in various lines. This brought about increasing liquidation and some relaxation in the stringency of the money market toward the end of the year. Throughout the entire period, the Federal Reserve banking system in this country was a bulwark of protection in conditions that otherwise might easily have precipitated financial disaster of farreaching consequences.

The deflation of wholesale commodity prices in the seven months ending December 1, 1920, according to one authority, was the most precipitous in recorded economic history of this country. Bradstreet's index figure on that date showed a decline of 34.2 per cent, this being even greater than the decline suffered in 1865, following the close of the Civil War.

Metal trades in 1919, in common with all other industries, suffered heavy declines, not only in prices current but in the volume of business transacted. Prices in every instance were near to, down to, or below prices for the same metal before the war. Large quantities of war stocks were thrown upon the market, while cancellations of foreign contracts were numerous and largely of an unwarranted character. Transportation difficulties within our own borders, however, and which were a serious handicap in 1919 and in part of 1920, were largely things of the past during the last quarter of 1920, the railroads having made rapid recovery in efficiency following their return to private ownership and the increase in freight rates.

Total sales of refined copper during the year, according to reliable trade estimate, were approximately 1,480,000,000 pounds, producers' prices declining from 19.25c. Jan. 1, to 13.00c. Dec. 31 for prompt electrolytic. In the outside market—which disposes of not more than 10 per cent. of production—the decline was from 19.00c. at the beginning of the year to 12.50c. at the close. Deliveries of tin into American consumption during 1920 were 52,540 tons, an increase of about 20,240 tons over 1919, while prices dropped from 60.37½c. Jan. 1, to 35c. per pound Dec. 31 on spot Straits metal in New York.

The volume of business in zinc, after the middle of the year, was disappointing and prices receded from 9.40c. per pound for prompt shipment to 6.10c. Dec. 31st. Producers' prices of lead declined from 7.75c. at the beginning to 4.75c. at the end of the year, while in the outside market, after being held at 8.00c. Jan. 1, was down to 4.62c. Dec. 31. Heavy stocks and light demand explain the drop in antimony prices from 9.75c. at the beginning to 5.20c. at the end of the year. Aluminum in the open market declined from 32c. for virgin 98-99% to 22-23c., while the producer's price Jan. 1 was 32-33c. and on Dec. 31 was nominally 32.90c., although sales of special lots, it was admitted, were being made at 28.50c. per pound. Quicksilver opened at $85 per flask of 75 pounds and closed at $45. Platinum sold at $160 per ounce Jan. 1 and at $75 per ounce Dec. 31, while silver declined from $1.30½ at the beginning to 64¼c. at the end. Old metals naturally followed the trend in major metals, with heavy declines in the entire list.

Net declines registered for the year were: Platinum, $85 per ounce; quicksilver, $40 per flask; bar silver of foreign origin, 66¼c. per ounce; silver, domestic origin, 31c. per ounce; Straits tin, 25⅜c. per pound; foreign aluminum, 9.50c., and domestic aluminum, 4.20c. per pound. Electrolytic copper declined 6.¼c., antimony 4.55c., lead 3.37½c. and zinc 3.30c. per pound.

In reviewing the year, it is interesting to note that, as was indicated in the outlook for 1920, in THE METAL INDUSTRY a year ago, prices advanced to their highest levels early in the year before the permanent decline set in, with only one exception—platinum—which opened at almost its highest level. The highest prices were electrolytic copper, 19.25-19.50c., established later in January after the open at 19.00-19.25c. Straits tin advanced to 65c. in January after the opening at 60.37½c. Lead, in February and again in March, was sold by the leading interest at 9.25c., after opening at 7.75c., while in the outside market the peak price was 9.50c. New York, in March, there being some scarcity of metal at that time—the opening having been 7.62½c. Zinc advanced to 9.85c. New York, 9.50c. St. Louis, after opening 9.404 New York, 9.054 East St. Louis. Antimony's highest level was 11.62½c. in February and early March, the opening having been 9.75c. Aluminum peak prices were 32.50c. in the outside market for foreign metal in August, while domestic metal reached its highest in September at 34.90c. for virgin, 98-99% pure. Quicksilver was at its highest, $103 per flask in February, silver $1.37½ in January, after its opening at $1.30½, while quicksilver opened at $85. The declines in every instance were due to readjustment of prices to the smaller volume of business primarily following the unsettled world conditions brought on by the Great War.

The outlook for 1921, in non-ferrous metals, seems to be that while continued contraction in the volume of business and possibly some further slight recessions in prices may be expected early in the year, later there will be recovery of a more or less substantial character in both when greater confidence in the future prevails.

COPPER

Refined copper production in this country in 1920, according to Geological Survey, was 1,573,000,000 pounds, as compared with 1,768,000,000 pounds in 1919, a decrease of only 195,000,000 pounds. Stocks of refined copper at the beginning of 1921 are estimated at 473,000,000 pounds, as compared with 631,000,000 pounds Jan. 1, 1920, a decrease of 158,000,000 pounds. Adding refined production of the year to existing stocks Jan. 1, 1920, indicates an available supply of 2,204,000,000 pounds. Exports during the year amounted to 663,000,000 pounds, which deducted from the total available supply leaves 1,541,000,000 pounds available for domestic consumption. Deducting the stocks of refined copper existing Jan. 1, 1921, from the available amount left for deliveries into domestic consumption leaves 1,168,000,000 pounds, whereas the Government reports American consumption 910,000,000 pounds, which reveals a discrepancy of 256,000,000 pounds. Smelter output in 1920, according to Government returns, was 1,235,000,000 pounds, against smelter output in 1919 of 1,286,000,000, which had previously been given by the Government.

Prices held remarkably during first quarter. Lake, after advancing to 20.50c. in January, at the end of March was 19.25c., the same as the opening level, Jan. 1. Electrolytic, after advancing ¼c. per pound in January to 19.50c., declined ½c. in February

and closed in March at 18.87½c. per pound. By the end of the second quarter, notwithstanding some buying that carried over from first quarter into April, Lake was off ¾c. to 18.50c., electrolytic and casting, each were down ⅞c. to 18.00c. for the former and to 17.62½c. for casting.

During the summer quarter, when buying power was further decreased, competition, which previously had been practically nil, developed, and Lake copper, after being quoted 18.50c. July 1, advanced to 19.00c., closing September 30 at its July opening, although it had declined to 18.25c. during that month. Electrolytic, after opening July 1, 18.12½c., also advanced to 19.00c., but closed September 30, 17.87½c., while casting, opened July 1, 17.75c., then advanced to 18.25c., and closed September 17.50c., a net decline of ¼c. By this time it had become painfully apparent that business generally was almost at a standstill; that deflation in prices must proceed and producers, who previously had maintained a firm attitude, accepted the situation, and prices dropped precipitously in the last quarter, although buying at no time was greatly stimulated. Lake, from 18.50c. Oct. 1, closed 13.75c. Dec. 31. Electrolytic from 17.87½ Oct. 1, closed 12.50-12.75c. Dec. 31, while casting held at 17.50c. Oct. 1, could be purchased 12.75c. Dec. 31. Producers' quotation at the end of the year was nominally 13.00c. per pound for prompt and first quarter 1921 deliveries as compared with 19.25c. at the beginning of 1920.

TIN

The tin market during 1920 was perhaps more active than any other non-ferrous metal, importations for the entire period amounting to 50,563 tons as compared with 35.404 tons received in 1919. Bolivian ores reduced to fine tin in the United States were 15,133 tons against 11,596 tons in 1919. Deliveries in December at both Atlantic and Pacific ports amounted to 2,580 tons, making total for 1920, 51,121 tons against such deliveries in 1919, amounting to 32,301 tons. Stocks and landing Dec. 31 were 2,856 tons—300 landing.

Fluctuations in prices of tin are always wide, but 1920 eclipsed previous records in a range of 32½c. per pound from the highest level 65c. per pound, to the lowest, 32½c., thereby cutting it in exactly one-half. An important development in the foreign situation is noted in the fact that the Malay government in an effort to stabilize the value of tin, has kept the price pegged at Singapore since the second week in December, at the equivalent of £225 c.i.f. London.

Spot tin prices in New York were not so well sustained as in copper, the net decline during first half of the year being 12⅛c. from 60.37½c. to 48.25c. on Straits; 11¾c. from 50.50c. to 47.75c. on American pure; 13¼c. from 59.50c. to 46.25c. on Banca, and 14c. from 59c. to 45c. on 99% tin. During third quarter the decline was less violent, but by Sept. 30, spot Straits, American pure and Banca were all down to the same level, 42.75c. per pound, while 99% metal was 41.25c. During last quarter, the decline was again accelerated, and by the end of December the net decline for the year was 25⅛c. on Straits to 35c. per pound; 25½c. on American pure to 34c.; 23½c. on Banca to 36c. and 28c. on 99% tin to 31c. per pound.

LEAD

Total production of lead in the United States in 1920, according to preliminary statistics issued by the Geological Survey, including that derived from foreign and domestic ores, was approximately 538,000 tons, as compared with total production in 1919 of 482,220 tons. Antimonial lead output decreased from 13,874 tons in 1919 to 12,000 tons in 1920. Exports were 22,500 tons, derived from foreign material, and 3,000 tons from domestic ores, indicating a total decrease during the year of 28,000 tons from the total 1919 outgo. Imports, owing to the decline in prices abroad and to the low exchange rates were heavy, 34,000 tons of refined lead coming to our ports during the year. A most unusual feature developed as a result of the importations, in the fact that prices were affected to such an extent as to decline sharply in meeting competition from foreign metal.

Prices fluctuated during the year from 9.25c., the highest level, to 4.45c. per pound, the lowest level. Unlike copper and tin, at the end of the first half of the year, June 30, prices showed a net advance. The basis of the leading interest was up ¼c. per pound to 8.00c. from 7.75c. Jan. 1. In the outside market, East St. Louis was up 47½ points from 7.62½c. to 8.10c., while New York had advanced 60 points, owing to scarcity at this point, from 8.00c. Jan. 1 to 8.60c. June 30.

During second half, however, the arrivals of foreign lead increased to such an extent that prices declined, showing by the end of September a decline of ¼c. New York to 7.75c. per pound; East St. Louis was off ⅛c. to 7.50c., and the American Smelting & Refining Co.'s basis was off ¼c. and back to 7.75c. again. In the last three months, with foreign arrivals still in the market and the generally adverse conditions becoming more aggravated, the decline was rapid and continuous. The year closed with the leading interest quoting 4.75c. per pound New York and East St. Louis, while in the outside market 4.60-4.70c. East St. Louis, 4.62½c. New York were the final quotations.

ZINC

Consumption of zinc in 1920, according to Geological Survey preliminary statistics, was about the same as in 1919, estimates being 324,000 tons in 1920 and 323,964 tons in 1919. Exports decreased, the outgo being 114,500 tons against 146,297 tons in 1919. Production of 463,000 tons showed a decrease of about 2,500 tons. Stocks at the end of the year were largely increased, there being 61,500 tons against 36,793 tons in 1919. As was the condition in lead, so was it in zinc—importations so heavy as to affect prices, which declined sharply in meeting competition from the English markets. The zinc offered was reshipment metal which had been sold during first half of 1920. When zinc from Germany and Belgium became available in European markets, prices were made so low as to make it profitable to resell earlier purchases from the United States at prices prevailing here, and to realize a profit in replacing requirements from Continental markets.

Prices fluctuated from the highest, 9.85c. New York, 9.50c. East St. Louis in January to the lowest, 6.05-6.15c. New York, 5.55-5.60c. East St. Louis, late in December. The opening was 9.40c. New York, 9.05c. East St. Louis for prompt Western shipments. Brass special opened at 9.15c.-9.12½c. New York and East St. Louis, respectively. The decline by the end of June amounted to 1.45c. New York, and St. Louis prices, June 30, were 7.95c. and 7.60c., respectively. During July and August there was some recovery at New York to 8.35c. and 8.05c. East St. Louis. From that time on the decline was continuous until the lowest level was reached Dec. 27, 5.50-5.60c. East St. Louis, 6.00-6.10c. New York, prices still being based upon shipments from abroad.

ALUMINUM

The entire 1920 American output of aluminum was reported sold early in the year, with large consumers' requirements well covered. This brought foreign metal into prominence in the outside market and into competition with any resale lots, which in the absence of active demand was responsible partially for the decline in prices. Full yearly statistics are as yet not available, but during first ten months arrivals were 15,388 tons, as compared with 7,876 tons reecived in all of 1919. Exports during the same period were 3,919 tons as compared with 2,235 tons outgo in all of 1919. Stocks remaining in bonded warehouses Oct. 31 were 1,082 tons.

Prices of the Aluminum Co. of America, at the beginning of 1920 were unchanged from the 1919 closing, 32-33c. virgin ingots 98-99% pure; 31-32c. remelted 98-99% pure, 29-30c. No. 12 alloy and 42.20c. sheets 18-ga. and heavier. On March 1, virgin ingots were advanced to 33c. and sheets to 44.20c., these figures remaining in force until August 17, when a new schedule announced a rise to 35.10c. for 99% and purer; 34.90c. virgin 98-99%; 34.10c. No. 12 alloy and 49.20c. sheets 18-ga. and heavier. On Oct. 1 this schedule was reduced 2c. per pound on each item, but with business now practically at a standstill, and cancellation of contracts previously placed, occurring, a further decline was announced late in December on special lots for strictly prompt shipment, to 28.50c. virgin 98-99% pure; 18.80c. remelted 98-99% pure; 27.50c. No. 12 alloy and 42.60c. for sheet. Thus, the net decline in producers' prices from Jan. 1 to Dec. 31 was 4.20c. per pound, but the total decline from the highest level to the lowest was 6.60c. per pound.

In the open market heavy arrivals of Norwegian metal during first quarter 1920, in the absence of demand, brought about a decline of ½c. per pound from the opening 31.50-32.50c. virgin 98-99% pure, 31.32c. 98-99% remelted; and 29.30c. No. 12 alloy. Continued heavy arrivals and war surplus kept the market oversupplied in the face of demand that was surely decreasing, and

finally ceased altogether. Naturally, prices were cut, from time to time, until in December the closing was at the lowest level of the year, 22-23c. virgin 98-99%; 2-22 remelted 98-99%; and 20-21c. No. 12 alloy, making a net decline of 9.50c. per pound.

ANTIMONY.

Antimony stocks, at the end of October, in bonded warehouses, were 1,561 tons. Arrivals during first ten months—full statistics not yet available—were 10,831 tons, as compared with 6,692 tons in all of 1919. Demand for antimony after the activity in January and part of February, when prices reached the highest level, 11.62½c. per pound on spot New York, duty paid carloads—was light, and prices continuously were lowered to induce buying, which at no time again became other than small. At the end of the year, spot carloads, duty paid New York, were offered at 5.20c. per pound, the net decline for the year being 4.55c., while the total drop from the highest level was 6.42½c. per pound.

SILVER.

The most prominent features in the silver market in 1920 were the establishment of two markets—one for silver bars of foreign origin and the other, pegged at a minimum price of 99½c. per ounce for metal mined and smelted in the United States—and the wide fluctuations which resulted in a net decline of prices—66c. per ounce on foreign bars and 31c. on United States bars. The Pittman Act was responsible for the separation into two markets and the minimum price for United States metal. Depression in all foreign exchanges because of prevailing world conditions brought about the low prices for foreign silver bars. Purchases made by the United States Government at $1.00 per ounce during the year were on Dec. 20, reported to be 29,177,737 ounces. Of this total, 5,000,000 ounces were turned over to the Director of the Mint for subsidiary coinage. This reduced the total amount—for replacement of the 207,000,000 ounces melted and sent abroad to stabilize currency in the Far East to help our allies—to 23,177,737 ounces. There is no time limit set, as to the coinage of standard silver dollars taken from the Treasury for this purpose, so it is impossible to determine when the minimum price of domestic silver bars shall cease. Output of silver in 1920 is estimated as being close to the 1919 production of 55,286,000 ounces, the smallest since 1909. Importations of silver from Jan. 1 to Dec. 20 were $86,725,000. Exports from Jan. 1 to Dec. 20 were $110,968,619.

There was but one market until June, during which month the decline carried below 99½c., which automatically pegged United States silver. Fluctuations during first half of the year carried from 1.30½c. Jan. 1 to $1.37 per ounce Jan. 12, the highest level, the lowest point in June being 80c. per ounce. The highest level in the second half was $1.01¾ in August, while the lowest level of the year was 59¼c. Dec. 10, after which there was a recovery to 64½c. on the last day of December. The total decline from the highest level, $1.37, to the lowest, 59¼c., was 77¾c. per ounce.

QUICKSILVER.

Total production in the United States during first nine months of 1920 amounted to 10,629 flasks. Stocks unsold at the end of September was heavy—3,834 flasks. Demand for quicksilver after first half of the year—during which time the highest price, $103 per flask, was reached in April—gradually decreased, and with the decrease prices declined, reaching the lowest level and closing price, $45 per flask, on December 29. The total decline, therefore, was $58 per flask, but the net decline was $40 per flask.

PLATINUM.

The increased use of platinum for industrial purposes was one factor in developing the scarcity that existed early in 1920, and which caused the price to remain at its highest level, $160 per ounce, following the opening at that figure, until Jan. 26, when there was a decline to $155. With increasing supplies and falling off in demand, prices declined to $80 in July, but made recovery to $115-120 in August, when demand from jewelers was at its height. In the last quarter, however, demand again fell off and prices receded to the lowest of the year, $75 per ounce at the end of December. Thus, there was a total and net decline of $85 from the opening and highest level.

OLD METALS

Old metals trade in 1920, while fairly active early in the year, suffered from lack of demand and declining prices later, in common with major metals, coming to a standstill in December, when the entire list showed heavy declines from prices Jan. 1. The heaviest was 22c. per pound to 16c. on No. 1 pewter, 21.50c. per pound to 25.50c. on block tin pipe. Aluminums were down 13c. per pound to 11c. for old cast, and off 11.50c. each to 12.50c. for old sheet and to 15c. for clippings. Coppers were off 6.50c. each, to 11c. for strictly crucibled, and to 10c. for uncrucibled wire, and down to 6.50 for heavy brass, and down 6.25c. to 8.50c. for light copper. Other items declined variously from 5.50c. on composition turnings and scrap to 1.75c. on old zinc from 4.75 to 3c. per pound.

WATERBURY AVERAGE

Lake Copper. Average for 1919, 19.55. 1920—January, 19.25.—February, 19.125.—Mar., 18.875.—April, 19.125.—May, 19.00.—June, 18.50.—July, 19.00.—August, 18.75.—September, 18.75.—October, 16.875.—November, 15.25.—December, 14.25.

Brass Mill Zinc. Average for 1919, 8. 1920—January, 9.75.—February, 9.40.—March, 9.15.—April, 8.85.—May, 8.30.—June, 8.15.—July, 8.45.—August, 8.55.—September, 8.45.—October, 7.50.—November, 7.00.—December, 6.40.

DECEMBER MOVEMENT IN METALS

	Highest	Lowest	Average
Copper:			
Lake	14.25	13.75	14.011
Electrolytic	13.75	12.75	13.478
Casting	13.37½	12.62½	13.125
Tin	36.25	32.50	34.152
Lead	5.10	4.45	4.808
Zinc (brass special)	6.37½	5.65	5.983
Antimony	5.75	5.20	5.458
Aluminum	26.00	22.00	23.826
Quicksilver (per flask.)	55.00	45.00	50.652
Silver (cts. per oz.) Foreign	70.00	59.25	64.784

Metal Prices, January 3, 1921

NEW METALS

Open Market

	Cents
COPPER—DUTY FREE. PLATE, BAR, INGOT AND OLD COPPER.	
Manufactured 5 per centum.	
Electrolytic, carload lots, delivered	12¾
Lake, carload lots, delivered	13¾
Casting, carload lots, delivered	12⅝
TIN—Duty free.	
Straits of Australian, carload lots	35¼
LEAD—Duty, Pig, Bars and Old, 25%; pipe and sheets, 20%. Pig lead, carload lots	4⅝–4¾
ZINC—Duty 15%.	
Brass Special	6.25
Prime Western, carloads lots	6.10
ALUMINUM—Duty, Crude, 2c. per lb. Plates, sheets, bars and rods, 3½c. per lb.	
Small lots, f. o. b. factory	....
100-lb., f. o. b. factory	....
Ton lots, f. o. b. factory	22-28.50
ANTIMONY—Duty 10%.	
Cookson's, Hallet's or American	Nominal
Chinese, Japanese, Wah Chang WCC, brand spot	5.20
NICKEL—Duty, Ingot, 10% ad valorem. Sheet, strip, strip and wire, 20%.	
Ingot	43.00
Shot	43.00
Electrolytic	45.00
MANGANESE METAL	Nominal
MAGNESIUM METAL—Duty 20% ad valorem (100 lb. lots)	$1.60-$1.75
BISMUTH—Duty free	2.40- 2.42
CADMIUM—Duty free	$1.40
CHROMIUM METAL—Duty free	Nominal
COBALT—97% pure	Nominal $6.00
QUICKSILVER—Duty 10% per flask of 75 pounds	45.00
PLATINUM—Duty free, per ounce	$75
SILVER—Government assay—Duty free, per ounce	.99½
GOLD—Duty free, per ounce	$20.67

Metal Prices, January 3, 1921

INGOT METALS

Silicon Copper, 10%	according	to	quantity	49	to55
Silicon Copper, 20%	"	"	"	36	to40
Phosphor Copper, guaranteed 15%	"	"	"	20	to29
Phosphor Copper, guaranteed 10%	"	"	"	19	to28
Manganese Copper, 30%	"	"	"	50	to56
Phosphor Tin, guarantee 5%	"	"	"	45	to55
Phosphor Tin, no guarantee	"	"	"	43	to53
Brass Ingot, Yellow	"	"	"	10	to11
Brass Ingot, Red	"	"	"	13¼	to15
Bronze Ingot	"	"	"	16	to18
Parsons Manganese Bronze Ingots	"	"	"	20	to21½
Manganese Bronze Castings	"	"	"	25	to35
Manganese Bronze Ingots	"	"	"	14	to17
Manganese Bronze Forgings	"	"	"	30	to40
Phosphor Bronze	"	"	"	24	to30
Casting Aluminum Alloys	"	"	"	20	to24
Monel Metal	"	"	"	38	to..

OLD METALS

Buying Prices		Selling Prices
10 to10¼	Heavy Cut Copper	11½to12½
9 to 9½	Copper Wire	10½to11½
8 to 8½	Light Copper	9½to10
10 to10½	Heavy Machine Comp.	12 to12½
6½to 7	Heavy Brass	8½to 9
4½to 5	Light Brass	6½to 7
5½to 6	No. 1 Yellow Brass Turnings	7 to 7½
9 to 9½	No. 1 Comp. Turnings	10½to11
4	Heavy Lead	4½
4	Zinc Scrap	4½
7 to10	Scrap Aluminum Turnings	8 to11
16 to18	Scrap Aluminum, cast alloyed	18.50to20.00
19.00	Scrap Aluminum, sheet (new)	21½
26.00	No. 1 Pewter	30.00
15.00	Old Nickel anodes	17.00
23 to25	Old Nickel	27 to29

BRASS MATERIAL—MILL SHIPMENTS

In effect January 1, 1921.

To customers who buy 5,000 lbs. or more in one order.

	Net base per lb.		
	High Brass.	Low Brass	Bronze.
Sheet	$0.19¼	$0.21	$0.22½
Wire	.20¼	.22	.23½
Rod	.17¼	.22	.23½
Brazed tubing	.33	..	.37¾
Open seam tubing	.33	..	.37¾
Angles and channels	.38	..	.42¾

To customers who buy less than 5,000 lbs. in one order.

	Net base per lb.		
	High Brass.	Low Brass.	Bronze.
Sheet	$0.20½	$0.22¼	$0.23¾
Wire	.21½	.23¼	.24¾
Rod	.18½	.23¼	.24¾
Brazed tubing	.34¼	..	.39
Open seam tubing	.34¼	..	.39
Angles and channels	.39¼	..	.44

SEAMLESS TUBING

Brass, 24c. to 26c. per lb. base.
Copper, 25c. to 27c. per lb. base.

TOBIN BRONZE AND MUNTZ METAL

Tobin Bronze Rod	21¾c.	net base
Muntz or Yellow Metal Sheathing (14"x48")	19¾c.	" "
Muntz or Yellow Rectangular Sheets other than Sheathing	20¼c.	" "
Muntz or Yellow Metal Rod	17¼c.	" "

Above are for 100 lbs. or more in one order.

COPPER SHEET

Mill shipments (hot rolled)	21½c.-22½c. net base
From stock	23½c.-27½c. net base

BARE COPPER WIRE—CARLOAD LOTS

16¼c. to 17¼c. per lb. base.

SOLDERING COPPERS

300 lbs. and over in one order	24½c. per lb. base
100 lbs. to 300 lbs. in one order	25½c. per lb. base

ZINC SHEET

Duty, sheet, 15%. Cents per lb.

Carload lots, standard sizes and gauges, at mill, 11½c. basis less 8 per cent. discount.

Casks, jobbers' prices	13½c.
Open casks, jobbers' prices	14c.

ALUMINUM SHEET AND COIL

Aluminum sheet and coil, base price, 49.10 per lb. 18 ga. and heavier, 47c. per lb.; 24 ga. and heavier, 42.5c. per lb.

BLOCK TIN SHEET AND BRITANNIA METAL

Block Tin Sheet—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more, 10c. over Pig Tin. 40 to 100 lbs., 15c. over 25 to 50 lbs., 17c. over, less than 25 lbs., 25c. over.

No. 1 Britannia—18" wide or less. No. 26 B. & S. Gauge or thicker, 500 lbs. or over, 8c. over N. Y. tin price; 100 lbs. or more, 10c. over Pig Tin. 50 to 100 lbs., 15c. over, 25 to 50 lbs., 20c. over, less than 25 lbs., 25. over. Above prices f. o. b. mill.

MONEL METAL

Shot	35
Blocks	35
Sheet Bars	40
Hot Rolled Rods (base)	42
Cold Drawn Rods (base)	56
Hot Rolled Sheets (base)	55

Lead Foil—base price—figured on base price of lead at the time.

Platers' metal, so called, is very thin metal not made by the larger mills and for which prices are quoted on application to the manufacturer.

SILVER SHEET

Rolled silver anodes .999 fine are quoted at from 66½c. to 68½c. per Troy ounce, depending upon quantity.

Rolled sterling silver, 64½c. to 67½c.

NICKEL ANODES

85 to 87% purity	.55c.	per lb.
90 to 92% "	.57½c.	per lb.
95 to 97% "	.60c.	per lb.

NICKEL SILVER (NICKELENE)

Base Prices

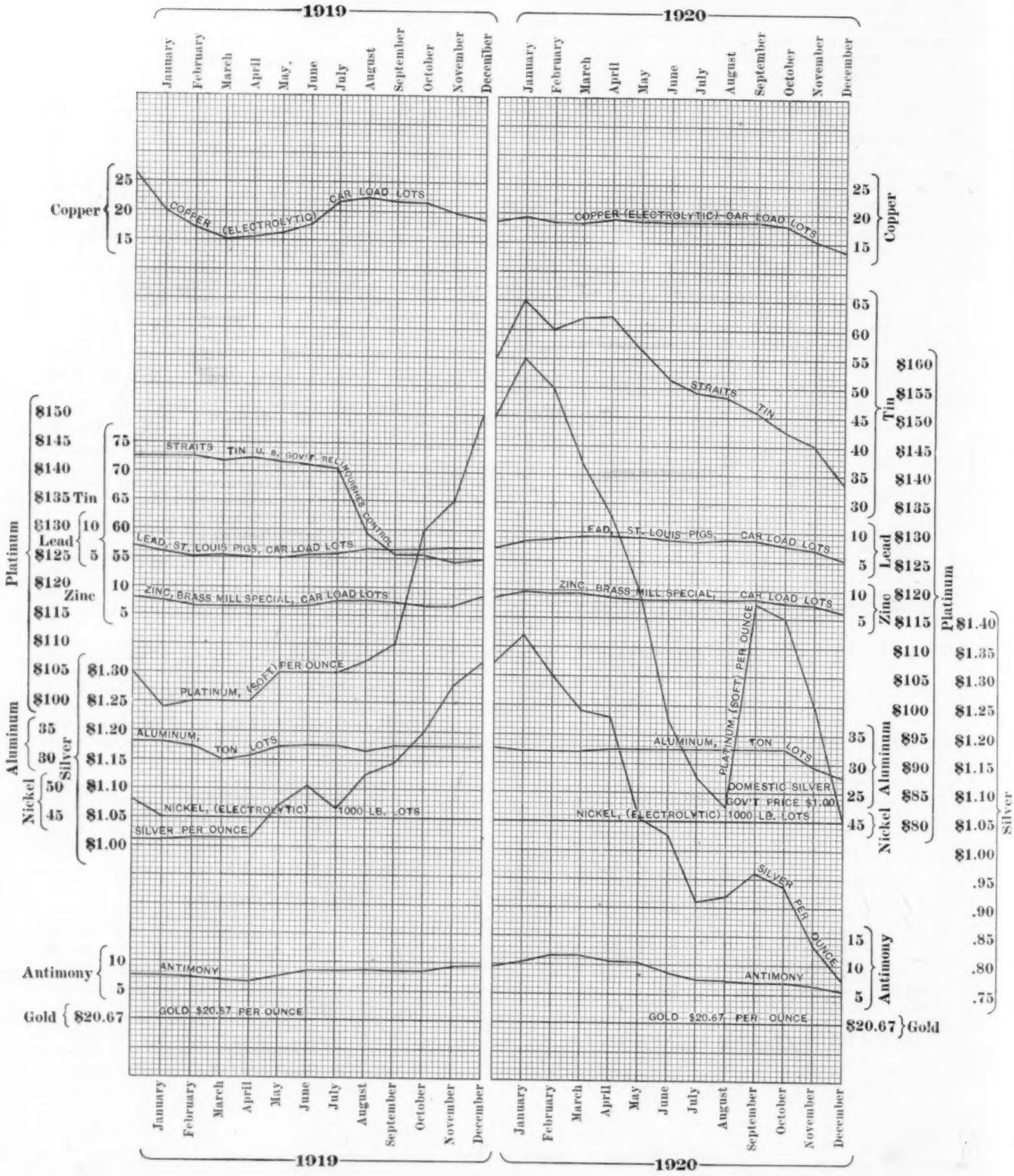
Grade "A" Nickel Silver Sheet Metal

10% Quality	32½c	per lb.
15% "	34¼	" "
18% "	35½	" "

Nickel Silver Wire and Rod

10% Quality	34¼c	per lb.
15% "	38¼	" "
18% "	41¼	" "

CHART OF METAL PRICES FOR 1919-1920



Pig Iron and Metal Products of the United States

Calendar Years 1911-1919. (1920 Estimated.)

(FROM THE UNITED STATES GEOLOGICAL SURVEY.)

PRODUCTS — Metallic	1911 Quantity	1911 Value	1912 Quantity	1912 Value	1913 Quantity	1913 Value	Products
Pig iron (spot value), long tons	23,257,288	$327,334,624	30,180,969	$420,563,388	30,388,835	$458,342,345	Pig iron
Silver, commercial value, troy ounces	60,399,400	32,615,700	63,766,800	39,197,500	66,801,500	40,348,100	Silver
Gold, coining value, troy ounces	4,687,053	96,890,000	4,520,717	93,451,500	4,299,783	88,884,400	Gold
Copper, value at New York City, pounds	1,097,232,749	137,154,092	1,243,268,720	205,139,338	1,224,484,098	189,795,035	Copper
Lead, value at New York City, short tons	391,995	35,279,550	392,517	35,326,530	411,878	36,245,264	Lead
Zinc, value at St. Louis, short tons	271,621	30,964,794	323,907	44,699,166	337,252	37,772,224	Zinc
Quicksilver, value at S. Francisco, flasks	21,256	977,989	25,064	1,053,941	20,213	813,171	Quicksilver
Aluminum, pounds	h46,125,000	8,084,000	h65,607,000	11,907,000	h72,379,000	13,845,000	Aluminum
Antimonial lead, short tons	14,078	1,380,556	13,552	1,311,348	16,665	1,591,854	Antim. L'd
Nickel, value at New York, pounds	890,000	127,000	†	†	481,565	79,393	Nickel
Tin, pounds	.....	56,635	.....	124,800	(k)	46,699	Tin
Platinum, value at New York City, troy ounces	940	40,890	1,005	45,778	1,034	46,530	Platinum
Total value of metallic products (b)	.....	$680,888,929	.....	$826,382,073	.....	$883,222,072	

PRODUCTS — Metallic	1914 Quantity	1914 Value	1915 Quantity	1915 Value	1916 Quantity	1916 Value	Products
Pig iron (spot value), long tons	22,263,263	$298,777,429	30,384,486	$401,409,604	39,126,324	$663,478,118	Pig iron
Silver, commercial value, troy ounces	72,455,100	40,067,700	74,961,075	37,397,300	74,414,802	48,953,000	Silver
Gold, coining value, troy ounces	4,572,976	94,531,800	4,887,602	101,035,700	4,479,056	92,590,300	Gold
Copper, value at New York City, pounds	1,150,137,192	152,968,000	1,388,009,527	242,902,000	1,927,850,548	474,288,000	Copper
Lead, value at New York City, short tons	512,794	39,998,000	507,026	47,660,000	552,228	76,207,000	Lead
Zinc, value at St. Louis, short tons	343,418	35,029,000	458,135	113,617,000	563,451	151,005,000	Zinc
Quicksilver, value at S. Francisco, flasks	16,548	811,680	21,033	1,804,631	29,932	3,768,139	Quicksilver
Aluminum, pounds	h79,129,000	14,522,700	.....	16,280,000	.....	33,900,000	Aluminum
Antimonial lead, short tons	16,667	1,572,167	23,224	3,665,736	24,038	4,483,582	Antim. Ld.
Nickel, value at New York, pounds	845,334	313,000	1,644,000	538,222	918	671,192	Nickel
Tin, pounds	208,000	66,560	204,000	78,846	280,000	122,000	Tin
Platinum, value at New York City, troy ounces	6,324	280,885	8,665	478,688	28,088	2,301,762	Platinum
Total value of metallic products (b)	.....	$691,081,734	.....	$991,729,648	.....	$1,629,507,000	

PRODUCTS — Metallic	1917 Quantity	1917 Value	1918 Quantity	1918 Value	1919 Quantity	1919 Value	Products
Pig iron (spot value), long tons	38,612,546	$1,053,785,975	38,230,440	$1,180,759,656	30,646,000	$809,246,000	Pig iron
Silver, commercial, value, troy ounces	71,740,362	59,078,100	67,810,139	66,485,129	55,285,196	61,966,412	Silver
Gold, coining value, troy ounces	4,051,440	83,750,700	3,320,784	68,646,700	2,829,395	58,488,800	Gold
Copper, sales value, pounds	1,886,120,721	514,911,000	1,908,533,595	471,408,000	876,563,692	243,761,000	Copper
Lead, value at New York, short tons	548,450	94,333,000	539,905	76,667,000	424,433	44,990,000	Lead
Zinc, sales value, short tons	584,597	119,258,000	492,405	89,618,000	452,272	66,032,500	Zinc
Quicksilver, value at S. Francisco, flasks	36,159	3,808,266	32,883	3,863,752	21,348	1,927,111	Quicksilver
Aluminum, pounds	.....	45,883,000	.....	41,159,000	(i)	(i)	Alum'm
Antimonial lead, short tons	18,646	3,781,560	18,570	2,826,350	13,874	1,513,968	Ant. Lead
Nickel, value at New York, short tons	402	331,556	441	401,000	511	434,485	Nickel
Tin, pounds	220,000	135,600	136,000	117,000	120,000 (short tons)	78,600	Tin
Platinum, value at New York City, troy ounces	38,831	4,023,757	59,753	6,517,980	40,220	3,987,813	Platinum
Total value of metallic products (b)	.....	$2,086,233,000	.....	$2,153,139,000	.....	$ (i)	

PRODUCTS — Metallic	1920 ESTIMATED* Quantity	Value Total	Value Per Unit
Pig iron, long tons (a)	36,414,114	$1,578,551,842	$43.35
Copper, pounds	1,350,000,000	236,061,000	17.486c
Gold, ounces, fine	2,419,013	50,000,000	$20.67
Antimonial lead, short tons	11,189	(i)	(i)
Lead, short tons	471,774	75,078,114	7.957c
Zinc, short tons	449,000	68,885,580	7.671c
Quicksilver, flasks	1,060,800	1,146,513	$81.123
Silver, ounces, fine	50,000,000	50,450,000	$1.009
Tin, short tons	(i)	(i)	49.10c

(h) Consumption 1911 to 1914. Production 1915 to 1918.
(i) Figures not available.
(k) Small production from Alaska, South Carolina and South Dakota.
(*) Figures from Engineering and Mining Journal. †Values included in total values. May not be shown separately.
(b) Includes some items of minor interest to metal trades not shown in table.
(a) From The Iron Age.

Supply Prices, January 3, 1921

CHEMICALS

Acid--		
Boric (Boracic) Crystals	lb.	.20
Hydrochloric (Muriatic) Tech., 20 deg., Carboys	lb.	.05
Hydrochloric, C. P., 20 deg., Carboys	lb.	.10
Hydrofluoric, 30%, bbls	lb.	.10
Nitric, 36 deg. Carboys	100 lb.	8.28
Nitric, 42 deg. Carboys	100 lb.	8.90
Sulphuric, 66 deg., Carboys	lb.	.04½
Alcohol—		
Denatured	gal.	1.25
Alum—		
Lump, Barrels	lb.	.07
Powdered, Barrels	lb.	.08
Aluminum sulphate, commercial tech	lb.	.06
Aluminum chloride solution	lb.	.30
Ammonium—		
Sulphate, tech., Barrels	lb.	.08½
Sulphocyanide	lb.	1.50
Argols, white, see Cream of Tartar	lb.	.80
Arsenic, white, Kegs	lb.	.18
Asphaltum	lb.	.35
Benzol, pure	gal.	.75
Blue Vitriol, see Copper Sulphate.		
Calcium Carbonate (Precipitated Chalk)	lb.	.20
Borax Crystals (Sodium Biborate), Barrels	lb.	.10½
Carbon Bisulphide, Drums	lb.	.12
Chrome Green	lb.	1.15
Cobalt Chloride	lb.	—
Copper—		
Acetate	lb.	.60
Carbonate, Barrels	lb.	.29
Cyanide	lb.	.63
Sulphate, Barrels	lb.	.08
Coppers (Iron Sulphate, bbl.)	lb.	.03
Corrosive Sublimate, see Mercury Bichloride.		
Cream of Tartar, Crystals (Potassium bitartrate)	lb.	.80
Crocus	lb.	.15
Dextrin	lb.	.25
Emery Flour	lb.	.10
Flint, powdered	ton	—
Fluor-spar (Calcic fluoride)	ton	—
Fusel Oil	gal.	6.50
Gold Chloride	oz.	14.00
Gum—		
Sandarac	lb.	—
Shellac	lb.	—
Iron, Sulphate, see Copperas, bbl	lb.	.03
Lead Acetate (Sugar of Lead)	lb.	.35
Yellow Oxide (Litharge)	lb.	.25
Mercury Bichloride (Corrosive Sublimate)	lb.	1.48
Nickel—		
Carbonate Dry	lb.	.80
Chloride, 100 lb. lots	lb.	.50
Salts, single, bbls	lb.	.16
Salts, double, bbl	lb.	.15
Paraffin	lb.	.30
Phosphorus—Duty free, according to quantity		.32-.38
Potash, Caustic, Electrolytic 88-92% fused	lb.	.32
Electrolytic 70-75% fused	lb.	.26
Potassium Bichromate, Casks	lb.	.17
Carbonate, 80-85%	lb.	.23
Cyanide, 98-99½%, 100 lb. cases	lb.	—
Pumice, ground, bbls	lb.	.05
Quartz, powdered	ton	—
Official	oz.	—
Rosin, bbls.	lb.	.07
Rouge, nickel, 100 lb. lots	lb.	.40
Silver and Gold	lb.	.60
Sal Ammoniac (Ammonium Chloride) in casks	lb.	.13
Silver Chloride, dry	oz.	1.20
Cyanide	oz.	—
Nitrate, 100 ounce lots	oz.	.53¾
Soda Ash, 58%, bbls	lb.	.03½
Sodium—		
Biborate, see Borax, bbls	lb.	.10½
Bisulphite, tech. bbls	lb.	.09
Cyanide, 96 to 98%, 100 lbs	lb.	.30
Hydrate (Caustic Soda) bbls	lb.	.05½
Hyposulphite, kegs	lb.	.06
Nitrate, tech., bbls	lb.	.07
Phosphate, tech., bbls	lb.	.06
Silicate (Water Glass) bbls	lb.	.03
Sulpho Cyanide	lb.	.90
Soot, Calcined	lb.	—
Sugar of Lead, see Lead Acetate	lb.	.35
Sulphur (Brimstone) bbls	lb.	.04
Tin Chloride	lb.	.40
Tripoli	lb.	.03½
Verdigris, see Copper Acetate	lb.	.60
Water Glass, see Sodium Silicate, bbls	lb.	.03
Wax—		
Bees, white ref. bleached	lb.	1.00
Yellow No. 1	lb.	.60
Whiting	lb.	.10
Zinc, Carbonate, bbls.	lb.	.26
Chloride, 600 lb. lots	lb.	.13½
Cyanide	lb.	.46
Sulphate, bbls.	lb.	.04

COTTON BUFFS

Open buffs, per 100 sections (nominal).		
12 inch, 20 ply, 64/68, cloth	base,	$45.30
14 " 20 " 64/68, "	"	56.25
12 " 20 " 84/92, "	"	57.95
14 " 20 " 84/92, "	"	78.10
Sewed buffs, per pound		
Bleached and unbleached	"	1.00

FELT WHEELS

		Price Per Lb.
White Spanish—		
Diameter— 8" to over 16"	Thickness—½" and ¾"	$4.00
" 8"	" 1" to 3"	3.10
" 10" to 16"	" 1" to 3"	3.00
" over 16"	" 1" to 3"	3.10
" 8" to over 16"	" over 3"	3.40
Grey Mexican—		
Diameter— 8" to over 16"	Thickness—½" and ¾"	$3.90
" 8"	" 1" to 3"	3.00
" 10" to 16"	" 1" to 3"	3.00
" over 16"	" 1" to 3"	2.90
" 8" to over 16"	" over 3"	3.30

Above are even diameters. Odd diameters 50c advance.